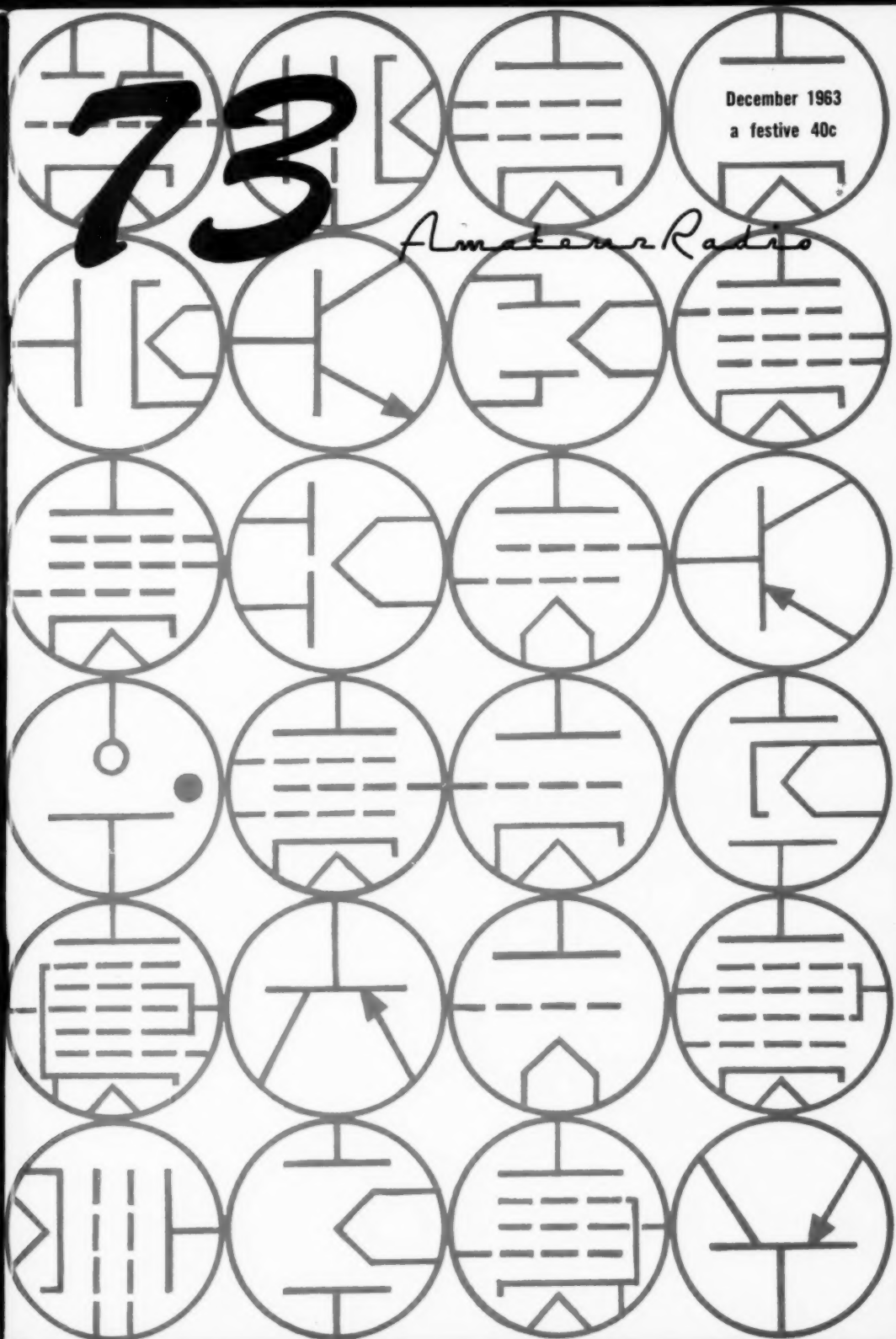
73

Amateur Radio

December 1963

a festive 40c



A DX-pedition QSL

A personal greeting to each of you in the brotherhood of Amateur Radio.

Season's Greetings

Joyeux Noel

Frohe Weihnachten

Feliz Ano Nuevo

Zaalig Kerstfeest

Buon Natale

Gladelig Jul

. . . and as thousands of world-wide users can attest, there is no finer communications equipment to be had—

HAMMARLUND MANUFACTURING COMPANY

73

Magazine

Wayne Green W2NSD/1
(no relation to Joe
Green, the composer)

Editor, etcetera

December, 1963

Vol. XIV, No. 12

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de W2NSD/1

never say die

It is not good to be back. Our little jaunt across Europe with 73 hams and wives was an extraordinary success from every standpoint and I think that most of us are busy driving all close friends and relatives out of their minds with stories of the fabulous foods we ate, the places we visited, the people we saw, the audience with the Pope, etc. I'll give you more details next month when I have had time to get some of my pictures developed.

As I talked to the leading amateurs in England, France and those gathered at Geneva I became more convinced that my ideas for preparation for the eventual Geneva I.T.U. conference have a greater possibility of keeping ham radio alive and healthy than any other plans put forward. I was particularly disappointed in the reaction of the ARRL to the situation.

To ennutshellify it, the ARRL plan is to woo the amateurs of other countries into being more favorably disposed toward U. S. amateurs by making *our* regulations stiffer. The ARRL'ers were considerably impressed by the severity of the amateur license exams in other countries as compared to the U. S. I found myself resisting the normal impulse to accept the European way of doing things as being better than ours.

Why should we accept their way of doing things? What results do they have to show for their system? Every single country is far behind us in amateur technical development, amateur operation and emergency service. They are behind us because they are hamstrung by restrictive regulations which have prevented the normal growth of amateur radio. If we want to do something to help amateur radio at the next frequency conference wouldn't we be doing a lot more if we were to do everything in our power to encourage amateurs in other countries to get their regulations relaxed enough to encourage a healthy growth? I think we have enough incontrovertible reasons for a strong amateur radio service to eventually sell even the most difficult foreign government officials.

This goes back to my editorial of last month wherein I discussed the basis and purpose of amateur radio. Amateur radio has been established in the U. S. to provide:

a) A non-commercial communication service.
b) Emergency communications.
c) Advancement of the art.
d) A reservoir of trained operators.
e) A reservoir of technicians.
f) A reservoir of electronics experts.
g) International good will.

We should look over this list with the question, "How many amateurs do we need to adequately fulfill the requirements above?" in mind.

Though one cannot assign definite numbers to each category, it is not difficult to set up a general working agreement. If we are to have a useful non-commercial communication service then we must have active amateur stations in every community. I would think that one active amateur station for every thousand people would meet this requirement. This should also hold for emergency communications, where this would seem to be a minimum desired concentration of amateurs.

We have shown here in the U. S. that the advancement of the art provided by amateurs is a function of the number of amateurs. Thus the more the merrier as far as this is concerned.

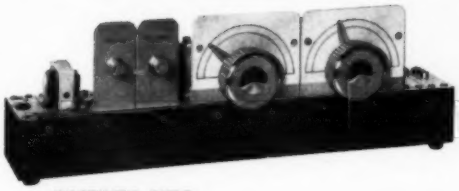
In time of war one of the country's greatest assets is a reserve of trained radio operators, technicians and experts. Amateur radio certainly did provide them during the last war when, I believe, almost 70% of the amateurs joined the military services. The service schools were staffed almost entirely by amateurs. The armed services could have easily used four times the number of amateurs that were available. Now, some twenty years alter, with electronics of far more importance than it was

(Turn page)

EXPERIMENTER, SWL or RADIO AMATEUR

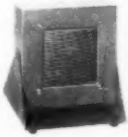
Select your receiver, transmitter, or VFO from easy-to-build International A O C kits.

Simple step-by-step instructions show you how to assemble factory prewired units. Designed for top performance at a low cost!



RECEIVER KITS

This new line of International receiver kits cover a wide range of amateur, citizens band and special frequencies. Designed for AM, CW, or SSB reception, this basic receiver using a superheterodyne circuit* with regenerative second detector may be expanded to a more elaborate receiver by the addition of other Add-On-Circuits. Sensitivity usable to below 10 microvolts for voice and 1 microvolt for code. Nuvistor rf amplifier, mixer, oscillator, I.F. transformer, detector/1st audio, and power audio amplifier. Tube lineup: 6DS4 nuvistor, 6BE6, 6U8, 6AQ5. Shipping weight: 15 lbs.



Receiver kit includes 4" speaker and power supply.

Kit	Frequency	Price
AOR-40	Special	$89.00
AOR-41	150 kc — 450 kc	62.50
AOR-42	2 mc — 6 mc	62.50
AOR-43	6 mc — 18 mc	62.50
AOR-44	80 meter/40 meter	62.50
AOR-45	15 meter/10 meter	62.50
AOR-46	6 meter	66.50
AOR-47	2 meter	66.50
AOR-48	Citizens 27 mc	62.50

*AOR-41 uses a tuned rf circuit with 6BA6

TRANSMITTER KIT

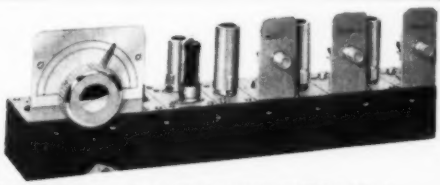
A compact package delivering a plate input of 50 watts for CW operation on 80 or 40 meters. 12BY7 crystal oscillator—6DQ6 power amplifier. Pi-network final. When used with AOR-44 receiver, transmitter operates from receiver power supply. Meter and TR switch.

AOT-50 transmitter kit less power supply and key, but with one 40 meter novice band crystal. Shipping weight: 5 lbs. **$35.00**

POWER SUPPLY KITS

AOP-100 350 volts, 150 ma intermittent or 100 ma continuous service, 6.3 volts @ 5 amps. Shipping weight: 8 lbs. **$18.50**

AOP-200 650 volts, 250 ma intermittant or 200 ma continuous service, 6.3 volts @ 10 amps. Shipping weight: 10 lbs. **$32.50**



VFO KITS

The International AOF series of variable frequency oscillator kits is available in three versions. For example, the AOF-91 kit is a complete driver unit to be used with 6 meter and 2 meter transmitters. Approximately .5 watt of power is available on both bands. Tube lineup: 6BH6 oscillator, OB-2 voltage regulator, 12BY7 buffer-amplifier/multiplier. Shipping weight: 5 lbs.

Kit	Frequency	Price
AOF-89	VFO 8 mc — 9 mc and buffer	$22.00
AOF-90	VFO 8 mc — 9 mc plus buffer multiplier and 6 meter output	29.00
AOF-91	VFO 8 mc — 9 mc plus buffer multiplier, 6 meter/2 meter output	36.00

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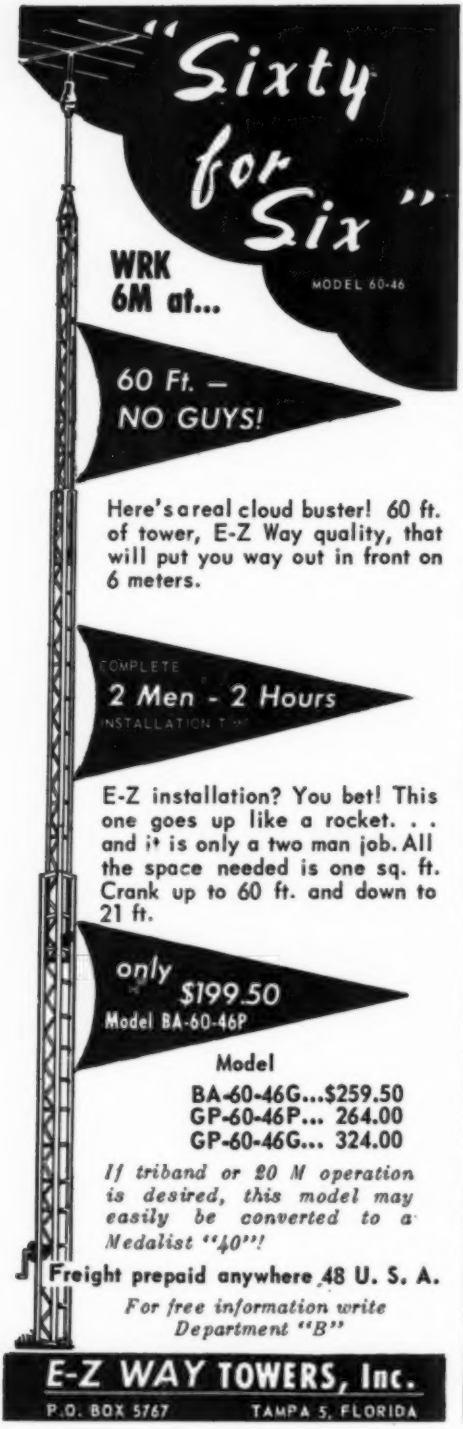
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then, the armed forces would need every man that amateur radio could provide.

Thus, if amateur radio is to achieve the goals set for it as a service by the FCC regulations, we find that we should have an active amateur population on the order of 200,000. I suspect that we have about half of this at present, despite the 250,000 licenses out. But, if we are short of our goal with 100,000 active amateurs, or about one amateur per 1800 of the population, how short are the French with about 2000 active amateurs, or one amateur per 25,000 population?

Perhaps instead of expending all of our energy on promoting such schemes as restricted voice bands we would do better to try to interest foreign governments in encouraging their amateur service by modeling their rules after ours, which have proven themselves. If France had 50,000 active amateurs the French would find themselves with all of the items on our list, a through g. They would also find that this number of active amateurs would bring about a tremendous increase in electronic manufacturing in France as a result of the demands for amateur equipment and parts.

I don't have to go into details as to the side benefits of having 50,000 radio amateurs. A goodly number of them, through their interest, will go into electronics and this would naturally result in a great increase in French electronics manufacturing of all kinds. In case of emergency the French Government would have 50,000 complete operating radio stations available for government use, plus operators, technicians, etc.

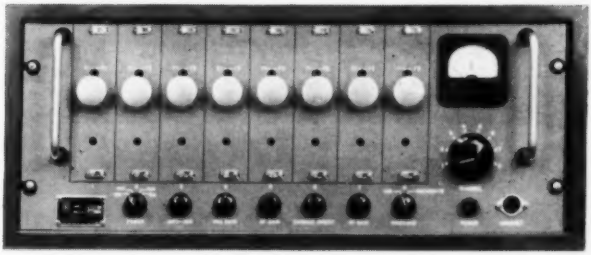
While I have used the French as an example, this same thought applies to virtually every other country in the world, and in particular to the newer countries, the ones that we are so afraid will upset our apple cart at Geneva in a couple years or so. If we went into an international conference with 1,000,000 active amateurs we might be able to regain some of the previously lost amateur frequencies and certainly wouldn't have to worry much about losses.

Now, which seems like a better approach to you? Should we set about making amateur radio more difficult here, restrict frequencies, and decrease our activity? Or would it be better to start working on getting amateur regulations eased in other countries, cutting down on import duties on amateur equipment and doing everything else we can think of to increase the number of radio amateurs throughout the world?

(Turn to page 30)

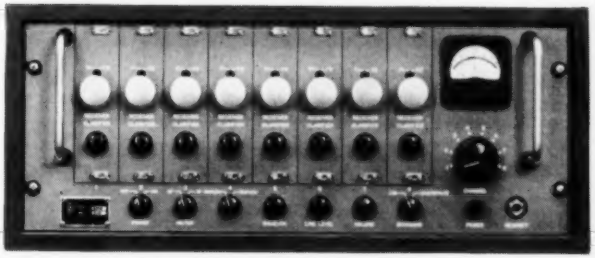
A COMPLETE SOLID STATE SSB EXCITER SME-I

and...



A COMPLETE SOLID STATE SSB RECEIVER SMR-I

providing



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MODEL SME-1
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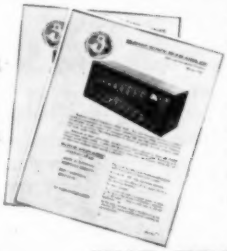

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Some Guys Make it . . .

and then there's us

Jean Shepherd K2ORS

You know, when you really step off a cliff, you know you've done it. It's just like looking out from the observation tower at the Empire State Building, and suddenly you're in mid-air and you know that there's no going back. I mean, it's a great flight, while it lasts.

It's maddening. You notice that up and down the street, the guys in the big Cadillacs never get tickets? Have you ever yet seen a ticket on a fat Mercedes? Let me tell you, I used to come back with my motor scooter decorated like a Christmas tree. You know, all those little green tags hanging like tinsel all over it. And in front of me would be a tagless Cadillac, and behind me a tagless Mercedes. Both parked there since last Easter. My scooter . . . I'd slow down, and the fuzz would be runing alongside me, tying 'em on.

Well, that goes in all directions. There are guys who always get it you-know-where, and there are guys who don't. It's just that way. Now I don't know how it's set. I don't know whether it's predestination. I don't know whether it's pre-ordained, but some guys from the very minute they're born—and they can be born in a rotten neighborhood—but from the very minute they're born, they are pre-ordained or something to Make It. And there are other guys who are born to be Sunk. I mean just born to it. Your ship is leaking. From the very minute you start to walk. Your shoes squeak. And you're phonying it up, and hoking it up from the time you're six. Other guys *win* the sack races. You know, legitimately. They can run faster.

Well, let me tell you what happened one time. I'm on the air, you see. I'm a ham, and this is when I began to discover this principle. I'm a kid, and I got this paper route —rout. It was both a route and a rout. It's terrible to have to admit that even when I was a paperboy, I was a paperboy for a paper that was about to go out of business.

Every week you'd come around and you'd try to collect, and they'd tell you they want to drop the subscription, it's a rotten paper. It's awful. I had a paper called the Herald-Examiner. Did you ever hear of it, the Chicago Herald-Examiner? And you know it was such a bad paper that they didn't even read it in my house, and we had a free subscription.

I used to go running around the neighborhood at four o'clock in the morning, delivering this rotten paper. It was a losing battle. And on Saturdays, every morning, I would go up and I'd knock on every third door, trying to collect the dough, and they'd say:

"Here's forty cents for last week. Please don't deliver the paper any more."

Well, then I'd have to go back and tell George The Paper Man that they quit down there, on Cleveland Street, those people down there, and he'd say:

"Ah, they're rotten people."

George was fighting a losing battle too, because he had the Herald-Examiner franchise in the neighborhood and he was going down with the ship. And all these poor little kids who were 12 years old and who were getting knobby knees from running around with this paper, they were going down too. Whereas right across the street from us there were a bunch of wiseguy kids who had the Tribune. And this big fat guy who had the franchise for the Trib. And they all got fat. All those kids are Republicans today. And Cub fans. All of the rest of us kids that had the Herald-Examiner, look at us. Ha! Democrats, follow-

ing the White Sox till the day we die.

So anyway, I'm a kid and I get my ticket, and I figure I'm licensed, like all the rest of the guys. Except, of course, the Cadillac has the same kind of license on it that you've got, you know. It's the same piece of metal on the back, but Boy, what a difference.

So I get my ticket. I'm really gonna swing. I'm on 40 cw for about six or eight months, when I get on 'phone. Now I'll tell you what I was doing as far as 'phone is concerned. I figure I'm gonna try and make it in the big leagues. And I have a single 2A5. Final driven by a 56 tri-tet osc. Do you know anything about the 2A5? Well, it was a Pentode, a Power Pentode. Receiving type. I got ahold of this 2A5, and I was using a Majestic B Eliminator, which I had found in the basement of somebody's house, to power this thing. And it put out 135 volts. I can tell you exactly what was running, it was 135 volts on the plate at 10 mils. So you can figure out what my input was. Into an RCA mismatched receiving doublet SWL antenna. A special design they had to mismatch on everything. Didn't match anything. I could have done better with the bedsprings.

And so I've got this thing tuned up, and I'm running a cool 135 volts at 10 mils on the plate. I built a modulator. Oh, when I think of it . . . how sad.

The modulator was another 2A5, and I am grid-modulating the final. Well, you can realize the kind of output I have. I'm probably running about 7/10ths of a watt, and you will never guess what band I'm running it on. I'm on 160 meters. Where a low power guy was running 200 watts and the high power guys ran all the way up to, well, I would say WNBC standards.

I had this poor little receiver. I don't know whether you ever heard 160 meters when it really was wild. You know what you could do on 160? You could tune into the band, and when you hit the band it was one hetrodyne from one end to the other. One *solid* hetrodyne, without a break. And the hetrodyne was of such a magnitude that your S-meter was on the pin all the way across the band. It never fell off.

So one night I'm on there. I throw my 7/10ths of a watt right into the middle of it all. I have a very vocal special sound, the bored sound of a high power man, calling CQ. Nonchalantly:

"Hello CQ, CQ. 160. Hello CQ, hello C2, Hello CQ". Then there's a little silence while I'm tuning. Sound of arc being drawn by pencil from final plate.

"Hello. One Two Three . . . hello. Hello CQ, hello CQ, hello CQ."

Where you really sound like a big leaguer is when you turn the radio in the next room all the way up, so you sound like you've got so much power and so much gain, so much preamp gain that you can't cut down the background noise in your house. It sounds real great.

I've got the cans on. I'm wearing cans monitoring myself on my receiver. I am the only guy who can hear me, the only guy who could hear my signal.

"Hello CQ, hello CQ, hello CQ, hello CQ."

It's 9 o'clock at night, and everybody in the country is on. Believe me, that band was so insane and my rig so weak that with my signal on and my receiver on, I could hear the hetrodynes through my carrier. If you know what I mean.

"Hello CQ, hello CQ, hello CQ, hello CQ 160, hello CQ."

I am calling CQ from 9 o'clock at night till 4 o'clock the next morning. All I am raising is our light bill. That's all that's happening. So the next night I come on again. I get on the air again, and it's great, you know, just to throw on all the switches. The one thing I had that was heartwarming was that my BH tube was leaky. I had a gassy BH. Did you ever hear of the BH cold-cathode rectifier? Well, it was leaky. It was gassy, it made a beautiful blue light like an 866 when I talked. Made me feel like I had real power.

"Hello CQ, hello CQ, hello CQ, hello CQ, hello CQ." And I'd see that blue light flickering. It was just great.

"Hello CQ, hello CQ, hello CQ, hello CQ."

Well, this goes on for one solid week. They can't even hear me in the next room. I haven't raised even a BCL.

"Hello CQ, hello CQ, hello CQ."

Finally Friday night comes along. Friday night comes along. And my friend Chuck, down the street is W9AHS. He is running 6/10ths of a watt on 20. He has not worked anybody on 20 since the preceding Spring, when he worked a guy who was mobile and who drove right past his house. So the two of us are in the same leaky rowboat.

Chuck comes home from school, and he says:

"You're on 160, huh? How're you doing?"

And I say:

"Ah, pretty good, Chuck. How are you doing on 20?"

Twenty is a real Big League band. He says:

"Oh, not bad. Not bad."

We both made Class A, you see, but I didn't

have the guts to go on 20 yet, because the band scared me.

Chuck says:

"What do you say we work a little Cross-band tonight?"

Chuck lived 10 blocks away from me. So I say:

"Okay, Chuck."

So Chuck has got his receiver tuned to 160 and I'm listening on 20 and sure enough, between all the hetrodynes I hear Chuck come in:

"Hello, hello W9QWN, hello W9QWN, W9QWN. W9AHS calling W9QWN."

So I throw on my transmitter. I'm on 160:

"Hello W9AHS, W9AHS."

And Chuck comes back to me! Fantastic! He could hear me. Right in between all the hetrodynes he says he could hear this little squeak, this little thing. He says:

"You're coming in. You're about an S-2. About an S-2. Readability is very low. About an R-3, I'd say, about every 3rd or 4th syllable."

So, without thinking about it, we slip into Cross-band work, into duplex. And I leave my transmitter on, Chuck leaves his on, and I'm talking to Chuck. We worked Cross-band, *duplex*, for not more than 30 seconds.

Illegal.

And I'm talking to Chuck, Chuck's talking to me, back and forth. It was great. Finally:

"73, Chuck."

"Okay. Dad."

"Hello CQ, hello CQ, hello CQ, 160 phone —hello CQ, hello CQ."

Six or eight weeks go by. When suddenly, in the mail, would you believe it? I get a card from the FCC. They got a listening station in San Diego. And they have ticketed me for Cross-band illegal operation. I am coming in there 599 XXXX. A ton of bricks! On 160!

Well. I figured, you know, there's some guys get ticketed and then there's others that don't. About that time I realized that there are born losers and there are born winners.

Oh well, it doesn't matter. It only gets worse. But the thing you got to keep saying to yourself is that it gets worse for everybody, simultaneously, all of the time. Maybe.

The QRP Kilowatt

William Starr WA4DQS
1851 West Oakland Ave.
Sumter, S. C.

Parts Kit . . available

One day about a month ago, KØDRI/4 and I were having one of our crosstown QSO's and he mentioned the article in 73 describing a QRP rig for 40 meters.* The outcome of the ensuing conversation is described here. KØDRI stayed in the spirit of things and built a real QRP transmitter, 675 milliwatts to a 1T4. I, however, got caught up in the mad rush for power and went the whole way—2.5 watts CW! Then of course came the logical next step, AM. I realize that all true blue QRP fans will rain curses on my head for introducing this overpowered station, but such is the price of progress.

* QRP Transmitter, 73 Magazine, March 1963.

Circuit

The circuit is quite straight-forward. A 6AH6 acts as a crystal oscillator-amplifier. The screen is fed with 150 volts regulated and acts as the plate of the oscillator circuit. It would be possible to use unregulated voltage here but I would be alert for chirps on CW and FM'ing on AM. Capacitor C-2 is an excitation control and more will be said on it later.

COMPRATCH?

COMPRESSOR — PATCH

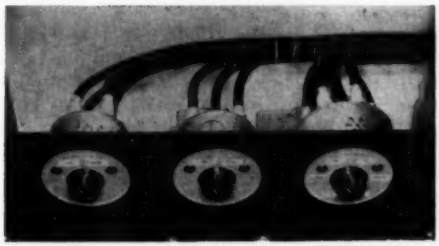
The NEW Waters Universal Hybrid Coupler (Model 3002) not only acts as a coupler between the phone and your transmitter and receiver (SSB too), but also has a built in compressor amplifier in the microphone circuit which can be adjusted from 0-12 db by a front panel control. This coupler can be used with a tape recorder if you aren't interested in phone patches. It can also be used with a tape recorder if you are interested in phone patching. Very versatile. $69.95

Retrokit: Modifies model 3001 to 3002: $19.95

EVT T.M.

Electronic Vernier Tuning for KWM2/2A. EVT is a stable solid state varactor tuning device that attaches to your PTO without wiring changes to give ±500 cycle tuning from your dial setting. Model 354 for use with KWM2 when used with Waters 337-M2 or 340-PT Q-Multiplier/Notch Filter or for KWM2A without Waters filters. Mounts without drilling front panel. $23.95. Model 355 for use with KWM2 with or without Waters filters. Mounts on front panel above band selector switch. $21.95

SWITCHES



Three types: one pole-six throw for antenna switching, $12.95; one pole-two throw in case you don't have so many antennas or want to use a dummy load, $11.45; transfer switch for switching power amplifier in and out, $11.45. All are canned for protection. All have SO-239 type connectors.

DUMMY LOAD WATTMETER

Handles 200 watts continuous, 1 kw intermittent (warning light when overheated). Scales: 10, 100, 1000 watts. 2-230 mc. 52 ohms. 4¾" x 9" x 10¼", 12 lbs. $79.75

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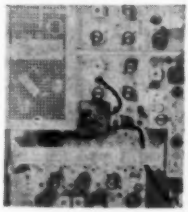
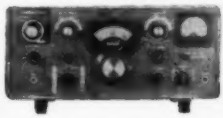
Transistorized
Tone modulator
3% Accuracy
Complete with:
Case, 7 coils
Model 331

$129.75



NQTCH FILTER



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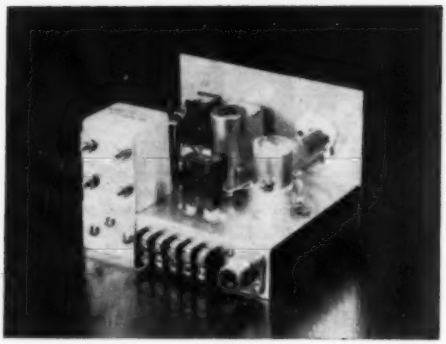
For KWM-2(A): 340-A	$53.75
No holes to drill.	

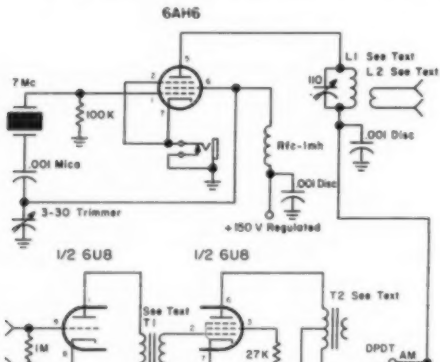
WATERS MFG. INC. WAYLAND MASS.



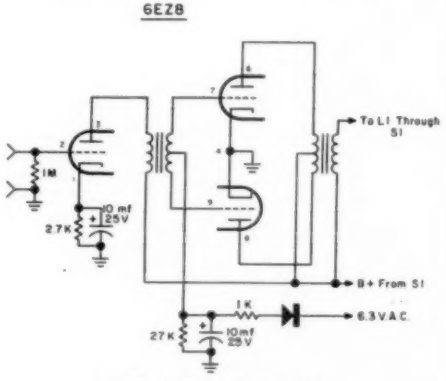
The speech amplifier and modulator section uses a 6U8 triode-pentode. Many experiments were made before settling on this tube and circuit. The final decision was probably due more to the contents of my junkbox than anything else. For those with an experimental nature and a better junkbox I recommend trying a EZ8 triple triode, running one triode as a voltage amplifier and the other two in push pull as shown in the alternate modulator circuit. A small rectifier working from the 6.3 volt AC filament supply provides -4 volts bias for this circuit. The only reason I discarded this modulator was my lack of modulation transformer of anywhere near the right value.

Construction

I built the rig on a 4" x 5" x 1" chassis made of scrap aluminum. The front panel is also scrap aluminum but with a coat of flat black paint and some decals added for looks. Coils L-1 and L-2 were wound on an old plastic pill bottle. The spacing on L-1 was achieved by winding two strands of wire at once and removing one after completing the coil. L-2 should be made movable so that the position for best output can be found. I did this by making a form out of stiff paper which was just large enough to slide over L-1. L-2 was then wound on this. Parts layout is not critical. Parts values are not critical with the exception of the cathode resistors on the 6U8. These should not be less than the values indicated or the plate dissipation ratings may be exceeded. The value for the excitation control, C-2, may not fall within the 3-30 mmf range in some cases, and it should be adjusted to meet the operating conditions listed later. Transformers T-1 and T-2 are products of my junkbox and I can't identify them precisely, but T-1 is a small input transformer with about a 1 to 3 ratio of primary to secondary turns. T-2 is a small output transformer with a center tapped primary. Feel free to experiment with values for these transformers, though. At one point in my trials I was using an old 400 cycle "power" transformer with fairly good results.



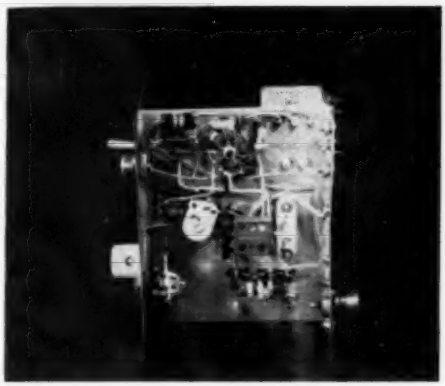
L-1—21T #26 enam. 7/8" dia., 13/16 long (see text)
L-2—8T #22 tinned 15/16 dia., 7/16 long (see text)
Y-1 7 mc crystal



ALTERNATE MODULATOR

Adjustment and Operation

The best tuning indicator I have found is the S-meter on my receiver. With the transmitter key down, tune C-4 for maximum S-meter deflection. An antenna or dummy load must be connected. It the rig stops oscillating when tuning C-4 through resonance, change the value of C-2. For initial tuning place the output link L-2 just below the bottom of L-1. When the best value for C-2 is found, adjust L-2 for maximum output. The value for L-2



shown is based on using 50 ohm coax to feed the antenna.

Any handy power supply may be used. Many receivers can supply the necessary values from the accessory plug. Total requirement for cw is 12 ma and for AM is 28 ma. The 6AH6 screen draws 2.5 ma from the regulated 150 volt supply. This little rig has given me excellent results. Harmonics are no problem if L-2 is adjusted properly and the modulation, though suffering somewhat from lack of audio power, is perfectly readable. With the values shown the rig can be used on 20 meters with 7 mc crystals if desired, although the tank circuit is a bit on the low C side for 20. If you want to use it on 20 meters primarily, L-1 should be cut down.

Parts Kit Available

A complete kit of parts, except crystal, is available for this project for $13.95.

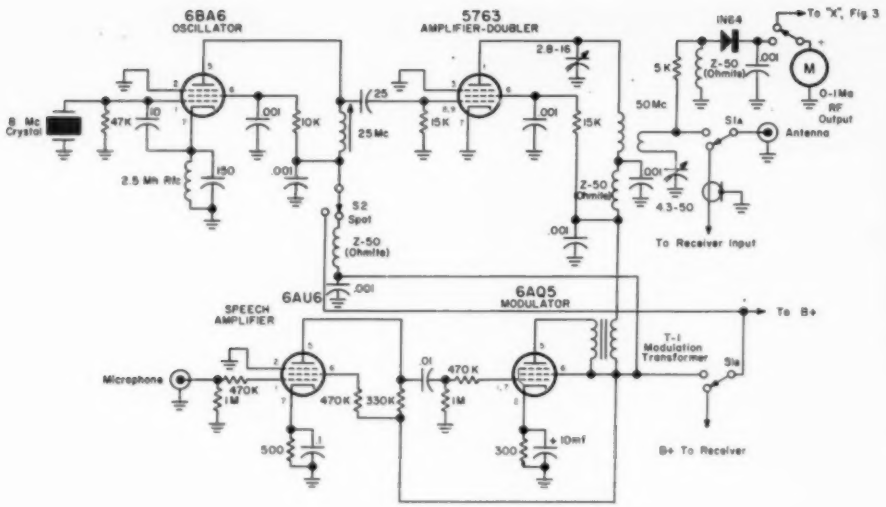
73 Peterboro, N. H.

6 Meter Transmitter-Receiver

Larry Levy WA2INM

There are many transceivers and transmitter-receivers (the difference being that a transceiver has audio stages common to transmitter and receiver sections) that have one common fault—a poor receiver section. There are good reasons for this, most of them involving money (on commercial gear) and/or complications of construction (home-brew grear) of a good front end and *if* strip. For the user of commercial gear, the solution is quite simple: buy the most expensive equipment made and then you will usually have a good receiver. For the home-brewer, there are several solutions to this problem. The most economical way, and in all probability the best performing, is to use an automobile receiver as the first *if*, second converter, and second *if*. Most automobile receivers are quite sensitive, having at least one stage of rf amplification before the mixer and having about two *if* stages around 262kc, which also makes them quite selective. Any way you look at it, these are the main requirements for a good receiver. This approach does eliminate the many cases of insomnia resulting from unstable *ifs* and transformers that won't stay aligned. It also saves a considerable amount of money over the cost of individual components, as an automobile receiver can be picked up for almost nothing at any junkyard. There is an article in the September, 1962 issue of 73, by W5VOH, on doing this. I feel that I have found a more convenient and simplified method. Completely rip out the existing power supply, remove the receiver chassis from the case and discard the rest of the case. This simplified conversion not only saves considerable space and eliminates all sorts of unnecessary complications; it will also look better when the chassis is mounted in another case, along with power supply, transmitter, modulator and converter.

The converter is one that uses several good points of VHF design and with minor modifications would make a good low noise con-

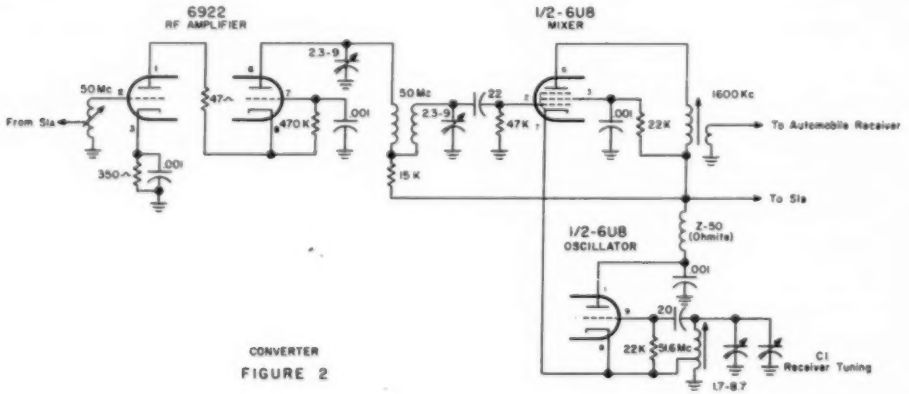


TRANSMITTER-MODULATOR

FIGURE 1

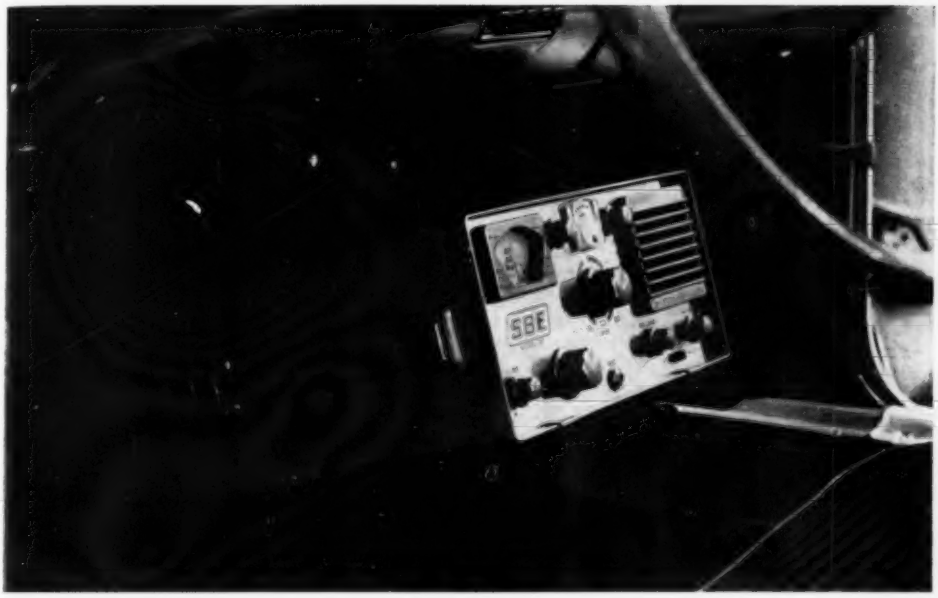
verter for a communications receiver. It uses an Amperex 6922 low noise cascode rf amplifier bandpass coupled to a 6U8 mixer. The bandpass coupling keeps the image level incredibly low considering the low frequency (1600 kc) *if* while the 6U8 mixer combines overload resistance with a low noise figure. The 6U8 is used as a tunable oscillator, tuning above the received frequency. Stability is good and I found no need for voltage regulation. The receiver tunes about 1 mc of the band with a National MCN vernier dial connected to the tuning capacitor. The output of the mixer is connected to the automobile receiver by means of a short length of coax link-coupled to the mixer plate coil. It is important that coax be used, well grounded at both ends, to eliminate the possibility of feedthrough from local broadcast stations.

The transmitter section is low powered, but not so low that it is inadequate to work stations that can be heard by the receiver. If more power is required, other tubes could be substituted in the transmitter that will increase the output several times. This does involve a larger modulator and power supply, and since this rig was built for economy, I felt that the increase in power was not worth it. The transmitter uses a 6BA6 oscillator-tripler driving a 5763 doubling in the final. This was done in the interest of economy and simplicity, and, while not completely conventional, it works



CONVERTER

FIGURE 2



SMALL INVESTMENT..BIG RETURN

SB-33, SSB transceiver is an exceptionally small package, but a few hours of on-the-air operation will convincingly point up the fact that the *only* thing small about SB-33 *is* its size. (and its price). Performance, on a multi-band, work-the-world basis is *big*—operating pleasure, owner satisfaction are in keeping.

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SBE uniquely uses "Bi-lateral" solid-state amplifiers and mixers which operate on both transmit and receive, and thereby reduces circuit elements and complexity, lowers costs while maintaining performance at high level.

Each investor wants the most for his dollar. *Compare SB-33.* Read all the fine print carefully! *SBE* gives you:

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and... upper or lower sideband selection by a front panel switch

and... a steep-slope Collins mechanical filter

and... a built-in speaker

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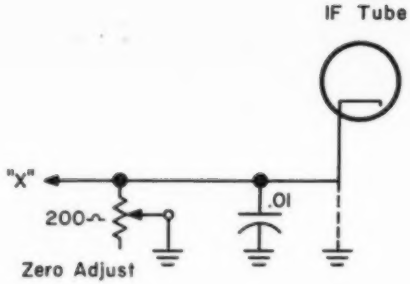


"S" METER

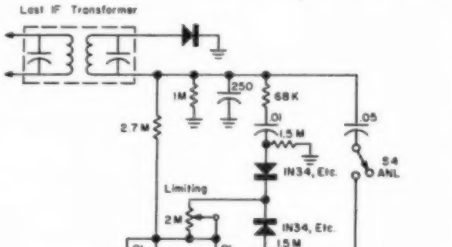
FIGURE 3

fine. The modulator uses a 6AU6 speech amplifier and a 6AQ5 modulator, transformer coupled to the 5763.

The power supply is a conventional full-wave supply, delivering about 250 volts at 150 ma. S1 is a dpdt switch used as a transmit-receive switch and S2 is a spdt spot switch. There is a 0-1 ma meter used for measuring rf output. Although it wasn't done in the original model, it could also be used as a S-meter by connecting it to a switch and metering the cathode current of one of the *if* tubes. The lead from the cathode is ungrounded and connected to S3. If it is possible, S3 could be combined with S1 by using a 3pdt switch so that the meter is automatically switched. The S-meter will lead backwards, that is, from 1 ma with no signal towards 0 ma with a strong signal. If this is inconvenient, you could always mount the meter upside down and paste some kind of a scale on it.

There is not too much that is critical in the construction but there are a few precautions that should be observed. In the receiver the 6922 rf stage is a high gain amplifier and will have a tendency to go into self-oscillation unless care is taken in the layout and construction. It is important that the antenna coil and the bandpass coil be at right angles to each other and well shielded, as well as all leads going near both coils. The two capacitors used for tuning the bandpass coil should be well grounded. If the unit is laid out so that any leads (heater, power, etc.) pass near both sets of coils, they should be well shielded. The heater lead to the two tubes in the converter should be shielded and bypassed at each tube. The oscillator coil should be mounted under the chassis and in a place where there is a minimum of heat. This coil should be wound on a ceramic slug-tuned coil form, with the tap being about 1¾ turns from the grounded end; the form used should have a ¼ inch diameter. A 1½-7 mmfd ceramic trimmer is mounted directly across the leads to the coil and the condensers used in the oscillator should be of the NPO variety. There were no problems encountered with stability so there was no need for voltage regulation of the oscillator. If it is desired, the oscillator could be crystal controlled and the receiver used as a tunable *if*, although the tunable oscillator method is preferred in this case. No problems should be encountered in connecting the output of the converter to the receiver or to actually get the receiver to work on AC. The only special part required in the converter is the tuning condenser which is made by removing all but one rotor and one stator plate from a 15 mmfd variable.

There aren't too many precautions that have to be taken with the transmitter because the final is doubling the frequency and therefore most of the problems usually associated with straight through final amplifiers, such as self-oscillation and other forms of instability, are absent. The oscillator coil should be kept away from the final plate leads and final plate coil. If possible, the oscillator coil should be mounted under the chassis and the final plate coil mounted on top of the chassis on the plate tuning condenser on the front panel. Care should be taken to keep the modulator leads away from the final tank leads. Shielded cable should be used for all signal carrying audio leads. It is important that neither of the 470K rf decoupling resistors are eliminated and that the grid side of these resistors have as short a lead as possible. The modulation transformer is a transceiver type transformer such as a Triad M4Z in which the speaker leads are not



AUDIO NOISE LIMITER

FIGURE 4

used. A push-pull audio output transformer will work fine, although it will probably result in some kind of impedance mismatch.

The units described can be built on subchassis and mounted in a case large enough to hold the automobile receiver chassis and the various sub-chassis necessary for the complete transmitter-receiver. After everything is mounted, the control circuits are wired as well as the cables and power leads interconnecting the various units. When doing this work, it is a good idea to make the leads long enough so that any unit can be pulled out for repairs without having to unwire the complete transmitter-receiver.

The next step is the conventional smoke test. This consists of applying power and noting where smoke is coming from, such as burning resistors, smoldering wiring, exploding electrolytics, etc. Once these conditions are corrected, the next step is tuning the transmitter. The transmitter tuning is quite simple, the only adjustments necessary is to tune the oscillator coil for maximum drive and peak the final tank for the largest deflection of the output meter. It might be helpful to use a #47 pilot light as a dummy load for checking the modulator. The bulb should get considerably brighter when you speak into the microphone. It will be necessary to have a high outputa crystal microphone to use with this modulator as there is not much extra gain. If more gain is desired, an extra audio stage, similar to the speech amplifier stage, can be added.

To get the receiver operating properly, it is first necessary to have the *ifs* aligned and be sure that the front end is tuned to 1600 kc and peaked. Use a strong signal around 50 mc and tune the oscillator until it is received. Peak the mixer plate coil for maximum signal strength and tune the antenna trimmer in the car radio for the same. Next tune the antenna coil in the converter and the first bandpass capacitor for maximum. Use another signal near 50.5 mc and peak the other bandpass capacitor. Now take a signal about half way in frequency between the previous two and peak the antenna coil. Now retune the bandpass capacitors using 50.1 and 50.5 as alignment frequencies, one capacitor to each frequency. Care must be taken in alignment as some of these steps are interacting and should be done in this order. Tuning the bandpass circuits will probably have the tendency to pull the oscillator frequency slightly so be sure that the signal is returned during peaking. After these steps are completed, the oscillator frequency can be set and the receiver calibrated.

DOW-KEY
DK-60 SERIES

COAXIAL RELAYS

Size
2¾x3¾x1⅛
Less than 9 oz.

4 VERSATILE MODELS, AC or DC OPERATION

UHF, N, BNC TNC and C CONNECTORS

COIL RATINGS: 6, 12, 24, 28, 32, 48, 110 and 220 V DC @ 2 watts. 6, 12, 24, 110 and 220 V AC @ 6 VA, 50-60 cps. Special coil voltages available on request. Coil terminals are solder connections feed-through insulators.

r.f. RATINGS: 1 kw power rating to 500mc. 20 watt power rating to 500 mc in DK60-G and DK60-G2C in de-energized position. The DK60-G and DK-60-G2C have a special isolation connector in the de-energized position to reduce crosstalk to a minimum.

AUXILIARY CONTACTS: Form 2C (DPDT) on DK60-2C and DK60-G2C, Bifurcated contacts rated at 5 amperes at 110 V AC non-inductive.

VSWR: Less than 1.15:1 from 0 to 500 mc (50 ohm load). 72 ohm relays available.

ISOLATION: Greater than 60 db @ 10 mc in DK60 and DK60-2C Greater than 100 db from 0 to 500 mc in DK60-G and DK60-G2C when in the energized position.

OPERATING TIME: Less than 30 milliseconds from application of coil voltage; less than 15 milliseconds between contacts.

Standard Relays with UHF Connectors include:

DK60	$12.45
DK60-G	$13.70
DK60-2C	$14.35
DK60-G2C	$15.65

NEW DK2-60B TRANSFER SWITCH

Designed to meet switching needs when using transceiver as exciter to drive any linear amplifier.

Performs necessary switching to either transmit directly with transceiver or to transmit with transceiver amplifier combination.

Distributors in U.S. and Canada.

SPECIFICATIONS: Freq. range 0 to 500 mc. to 1 kw; VSWR 1.15:1; Isolation 30 db at 500 mc, 50 db at 30 mc; Insertion loss 0.03 db at 30 mc; Available in all std. AC and DC voltages. Connectors: UHF std., type N, BNC, TNC and C available.

DK2-60B with UHF Connectors.... $19.00

DOW-KEY COMPANY
Thief River Falls, Minnesota

The rig should now be ready for use on the air. One of the first contacts made with the station was over 300 miles away with S7 reqports on both ends. It is also quite easy to make skip and extended ground wave contacts reliably. The receiver is one of the best I have ever used in a rig of this type and compares favorably in sensitivity, selectivity, and noise figure to many communications receivers, including my own, with its nuvistor converter. With a nuvistor preamplifier, I am sure that the noise figures would be equal, although the measured difference was less than 1 db.

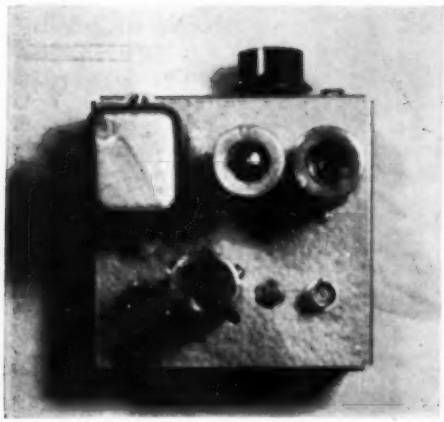
With all of these features, the rig can be made for less than $25, assuming that you are fortunate enough to talk the properieter of the local junkyard out of an automobile receiver at a reasonable price. There are many possible modifications of this idea that can be used. It is possible, for example, to add push-to-talk by replacing S1 with a relay. The rig can also be modified for different bands by just changing some of the coils. The transmitter and converter could be built into a small box and connected to an existing automobile receiver in a car and used as a high performance mobile station, after a modification of adding a noise limiter is made to the automobile radio. While on the subject of noise limiters, none was included in the original design. From my location, near the top of Hogback Mountain, Vermont (a favorite location for hilltopping), the signals are strong enough and the college is far enough away from the main road so that ignition noise is so rare that no limiter is necessary. For those who would like to install a noise limiter, the circuit modifications necessary are shown in Fig. #4. The diodes can be any general purpose diode, providing they are both of the same type. Diodes having a high forward to reverse ratio will have the most effective limiting characteristics. The limiting control should be adjusted for maximum limiting without distorting the received signal. Adjustments should be made to set the limiting to the point of distortion and then back off slightly. This operation should be carried out on a reasonably strong signal as if it is done on a weak one, it will tend to distort on strong stations due to the non-linear avc characteristics of automobile receivers.

There are several things that can be done to improve the appearance of the rig, such as spraying the panels, using illuminated meters, decals, etc. If care is taken in construction, the result will be a rig that will far outperform comparable commercial equipment, be just as attractive, and cost a small fraction of the price of store bought gear. . . . WA2INM

A novel approach to

50mc DSB

Will the author of this article please identify himself?



Those of you who are experimentally inclined will, undoubtedly, be interested in this unique double-sideband balanced modulator.[1]

The double-sideband balanced modulators most of us are familiar with generally utilize two pentodes operating in push-push, with the audio signal applied to the screen grids. The balanced modulator, to be described, differs from this in that it utilizes a twin-triode with the audio signal applied to the cathodes.

From a quick glance at the schematic it will be obvious that no B plus power supply, as such, is used for the balanced modulator.

Operation

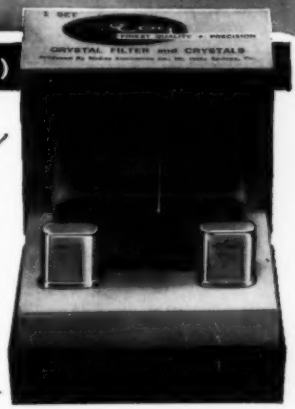
A low level 50 mc signal is applied to the

[1] Better Double Sideband, Cameron, CQ, March 1959, page 28.

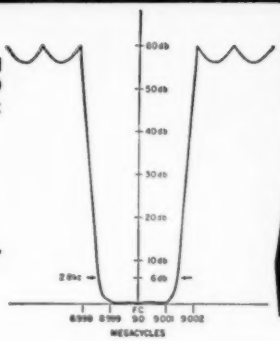
Now! for discriminating amateurs who are satisfied with nothing less than *THE VERY BEST*

McCoy SINGLE SIDE BAND FILTERS

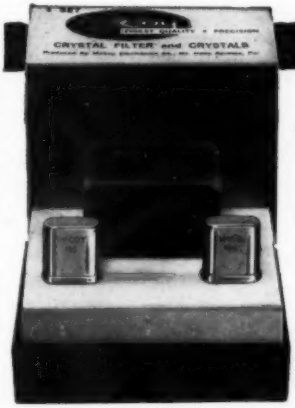
The GOLDEN GUARDIAN (48B1)

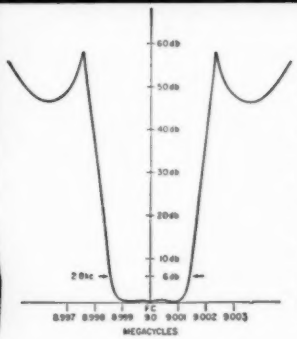


TECHNICAL DATA
Impedance: 640 Ohms in and out (unbalanced to ground)
Unwanted Side Band Rejection: Greater than 55db
Passband Ripple: ± .5db
Shape factor: 6 to 20db 1.15 to 1
Shape factor: 6 to 50db 1.44 to 1
Package Size: 2⅛" x 1 19/32" x 1"
Price: $42.95 Each



The SILVER SENTINEL (32B1)





TECHNICAL DATA
Impedance: 560 Ohms in and out
Unwanted Side Band Rejection: Greater than 40db
Passband Ripple: ± .5db
Shape factor: 6 to 20db 1.21 to 1
Shape factor: 6 to 50db 1.56 to 1
Package Size: 1¾" x 1¼" x 1"
Price: $32.95 Each

Both the Golden Guardian and the Silver Sentinel contain a precision McCoy filter and two of the famous M-1 McCoy Oscillator crystals. By switching crystals either upper or lower side band operation may be selected. Balanced modulator circuit will be supplied upon request.

Both sets are available through leading distributors. To obtain the name of the distributor nearest you or for additional specific information, write:

McCoy ELECTRONICS CO.
Dept. 73-12
MT. HOLLY SPRINGS, PA.
Phone: HUnter 6-3411

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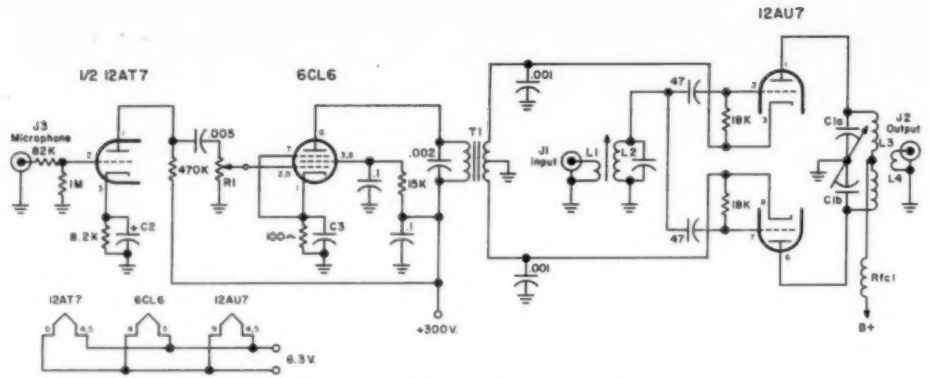


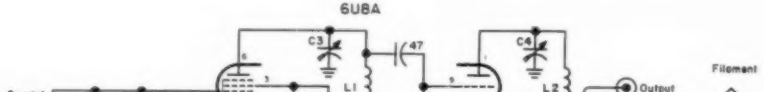
Parts List

R1	500 k pot. Allied Catalog # 30 M 322.	J3	Microphone jack.
C1	Butterfly variable capacitor: 26 pf. per section. E.F. Johnson 167-22. Allied Catalog number 75L927	L1	1 turn #20 enam., wound at cold end of L2.
		L2	10 turns 24 enam. ½" long, wound on¼" diam., powdered iron core, slug tuned form.
C2	1 Mfd., 100 volts. Allied #11LO26	L3	10 turns #20, ½" diam., ¾" long, center-tapped.
C3	35 Mfd., 50 volts. Allied Catalog #16L662.	L4	10 turns #24 enam. ½" long, wound on ¼" L3.
RFC1	8.2 microhenry R.F. choke. Allied catalog #60 G 439.	T1	Audio transformer.
J1, J2	BNC connector: UG-1094U.		

parallel connected grids of the 12AU7. However, unless we are modulating, there is little or no potential difference between the cathode and plate of either section, therefore the tube cannot conduct. Now, when we modulate, an audio voltage will be applied to the cathodes of the 12AU7 through transformer T1. At any instant of time, one triode section will see the positive half cycle of the audio signal at its cathode and the opposite triode section will see the negative half cycle. The triode section that is seeing the positive half cycle will not conduct because its cathode is more positive than its plate. However, at this same instant of time, the opposite triode section's cathode is seeing the negative half cycle and it becomes more negative than its plate. Now, if the cathode is more negative than the plate, the plate may be said to be less negative, or more positive, than the cathode. Under these circumstances the tube will conduct. The dc power input, at any instant, is equal to the potential difference between plate and cathode, at that instant, multiplied by current flowing through the tube at that instant.

As you see, from the preceding, the power for the balanced modulator is actually derived from the audio signal.

While this method of double sideband reduced carried generation is different, it certainly has more than just that to recommend it. This circuit has the tremendous advantage



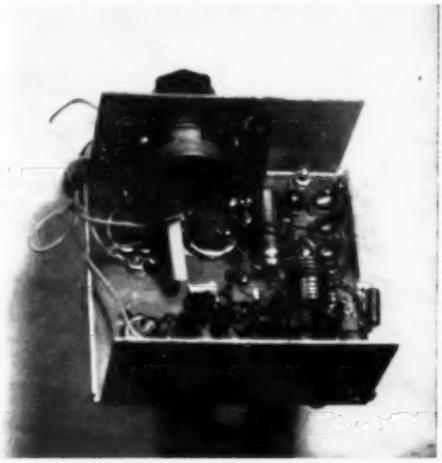
OPTIONAL R.F. EXCITER

Parts List

RFC1	750 microhenry RF choke. Allied catalog #60G478.	C4	15 pf. midget variable. Hammarlund HF-15. Allied catalog #72L215.
C1	10 pf., silver mica.	J1	BNC. coax connector. UG-1094U.
C2	100 pf., silver mica.	L1	16 turns B & W 3008 Miniductor.
C3	35 pf. midget variable. Hammarlund HF-35. Allied catalog #72L216.	L2	5¼ turns B & W 3007 Miniductor.
		L3	1 turn #20 enam., wound at cold end of L2.

of being capable of delivering much better sounding audio than one generally hears from double sideband transmitters.

The power output of this balanced modulator is low, and while you could operate it "barefoot," it will give far better results if it is used to drive a low power linear amplifier. Its output is sufficient to drive a class "A" 6CL6, 5763, or equivalent type tube.



An rf exciter is not shown in the schematic (although the schematic of an optional RF exciter unit is provided elsewhere in this article for those who may need it) as I used the buffered 50 mc output of my VFO to drive the balanced modulator. Any low powered 50 mc exciter will serve the purpose equally well. One word of caution: if you should use a 50 mc overtone oscillator to drive the balanced modulator, I would strongly recommend the use of a buffer stage between the oscillator and the balanced modulator. This will provide some degree of isolation and lessen the chances of pulling the oscillator frequency when modulating. Pulling of the oscillator frequency would make it extremely difficult for another operator to tune in the signal on his receiver, as anyone who has ever tried to tune in an unstable SSB signal can attest! It goes without saying that the power supply for an overtone oscillator should be voltage regulated.

The layout is not critical, although some care should be taken to maintain symmetry in the balanced modulator. The cathode bypass capacitors of the 12AU7 balanced modulator should be mounted as close to the tube socket as possible, with short leads. These capacitors provide an rf ground return for the cathodes

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of the 12AU7, but they also control the frequency response of the audio by clipping the highs.

The gain of the audio section is fairly high so a little care should be exercised here to prevent audio feedback in the amplifier as well as rf feedback into it. No trouble was experienced along these lines, but the possibility exists if one is not careful.

Neutralization of the balanced modulator is unnecessary. Being a push-push stage, it is inherently self-neutralized. No trouble with parasitic oscillations was encountered.

This DSB generator is very flexible and its design leaves room for many variations and ideas the individual constructor may want to experiment with. A few things that might be added are: Speech clipping, VOX, linear amplifier, etc.

The entire unit was constructed on a minibox chassis measuring: 4" x 4" x 1½". This can be altered to suit the desires of the individual.

VHF Contest Special

A dissertation on the use of the Corner Reflector on 144 mc

Adam Keller K9SGZ
Valparaiso Technical Institute
Valparaiso, Indiana

When the author undertook the construction of this particular antenna, it was with the thought in mind of producing a low cost, moderate gain, easily portable antenna for use in VHF parties. As it turned out, the antenna performed far beyond our wildest expectations and was surprisingly easy to build and match. This article is primarily concerned with putting this antenna on 144 mc, but data will be given which will enable the interested builder to construct it for any desired frequency band.

I must confess that when K9HYV first cornered me and mentioned building this antenna, I had my doubts about it ever comparing with a good yagi. The gain figure given by Dr. Kraus [1] in his fine book was only about 10.2 db for a 90 degree corner, which we had decided on due to size and portability requirements. However, the broad front lobe of the radiation pattern seemed to have a very desirable characteristic in that most portable set-ups generally use the "armstrong" method of rotation and any time saved in running back and forth to the mast is pure gold. So, with reservations in mind, we decided to try one of these beasts and compare it with a commercial 10 element yagi which was already in the sky at K9SGZ.

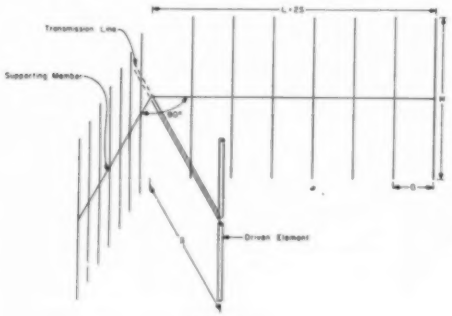

FIGURE 1

Our first problem was with the dimensions to be used on this 90 degree corner. We decided to use RG/11U coax as we had some on hand, so consulting the graphs in Kraus we find that the dimension "S" (Fig. 1) should be about .35 wavelength to provide a terminal radiation resistance of 72 ohms. If 52 ohm coax, such as RG/8U is used, a dimension "S" of about .32 wavelength will give an excellent match. The length of the supporting members is then determined to be at least "2S." This is a minimum dimension, but any larger figure will give very little improvement, if any. The length of the reflectors, H (Fig. 1) is then determined to be equal or greater than 0.6 wavelength, and the spacing between re-

[1] Kraus, **Antennas**, see Radio Bookshop #5.

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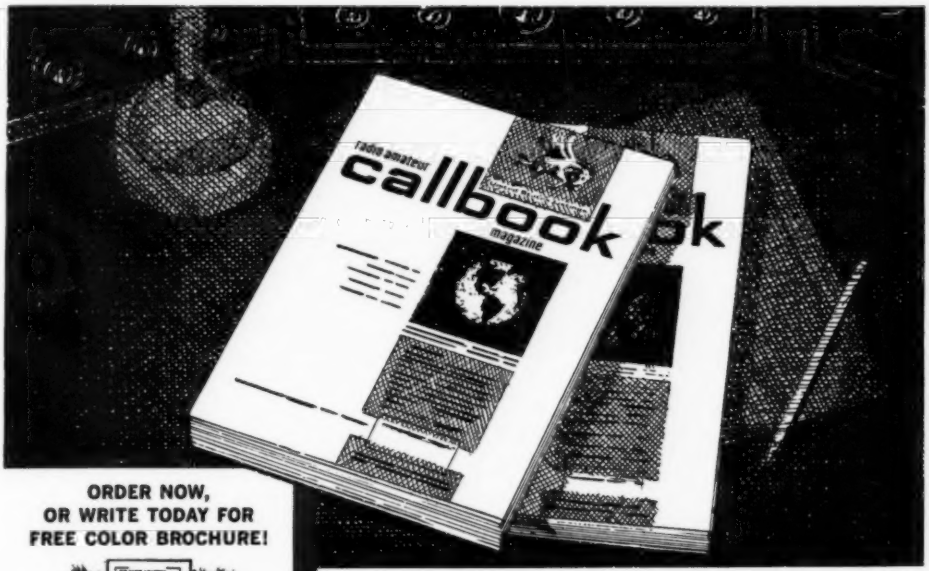

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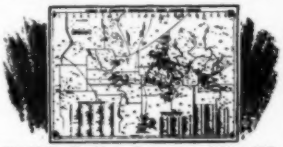

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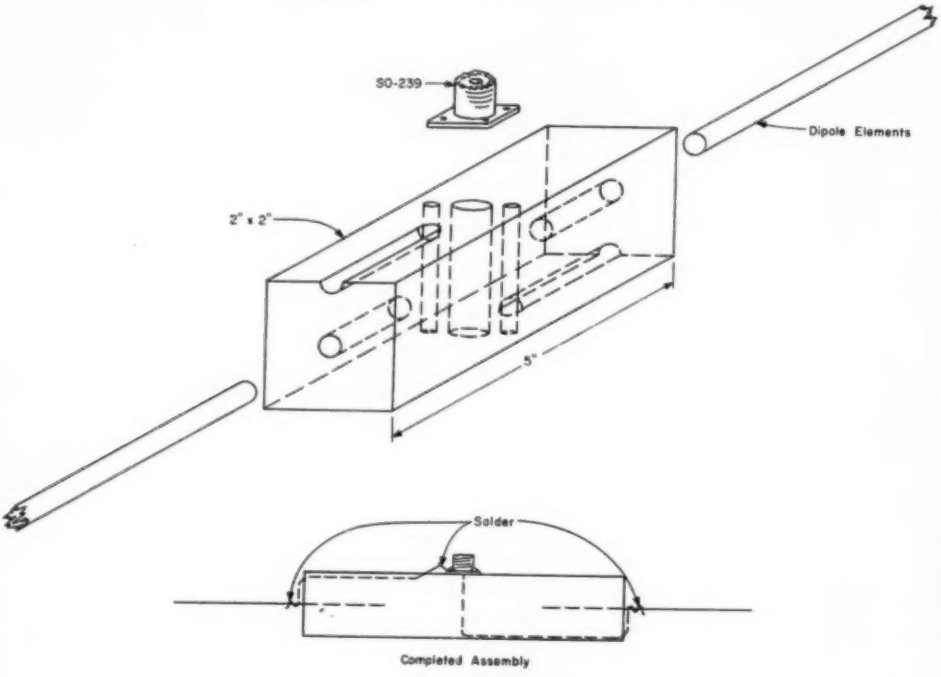
flectors, G, should be 0.1 wavelength or less. These last two dimensions are not at all critical, and are only guides to be used to find out how little wire needs to be used for reflectors. A table of dimensions follows, for use at 144.5 mc.

Dimension (Fig. 1)	length in inches
S	28½
2S	57
G	8
H	49

It should be noted that these dimensions will allow the use of this antenna over the lower two megacycles of the two meter band with very little degradation. The bandwidth of the corner reflector is approximately *60%* of the center frequency, which is quite a drastic change from the very critical dimensions of the popular yagi style.

Thusly armed with the dimensions, a yardstick, hacksaw, etc., we attacked the monster with vigah. Our first try was made completely out of aluminum, but 2 x 2's seem to be the more logical approach. The first step was to unroll and straighten the 57 feet of aluminum clothesline wire needed for the reflectors. We used the old trick of tying one end to the car frame and the other to a convenient tree, then just a slight pull, and *voila*, straight wire. After cutting up the 14 reflectors needed, the supports were readied for assembly. Two pieces of 2 x 2, each about 57 inches long, are drilled every eight inches with a hole which just allows passage of the aluminum wire you choose for reflectors. Another hole is then drilled into each of the reflector holes, but at right angles to the reflector holes. These allow wood screws to be tightened down on the reflectors to hold them in place when they are inserted in the holes. Two holes are also drilled at this time, one in each support, for the bolts which will hold the antenna to the mast. These should be about 39½ inches from the vertex of the angle formed by the two supports. The two supports are then given a coat of varnish for weather protection and are fastened together at the vertex by an ordinary cabinet door hinge.

The mast is next readied for assembly. A short piece of mast which will mate with the mast from the top of your tower may be used here. Six feet of mast will do nicely for 144 mc. Two holes are drilled in this mast to accept the bolts which go through the large holes in



DIPOLE MOUNTING DETAIL
Figure 3

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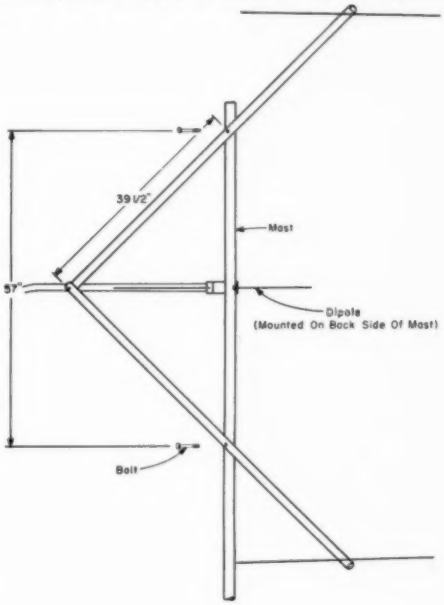
the two wooden supports, and should be 57 inches apart, spaced as near the top of the mast as possible. Midway between these two holes, mounting holes for the driven element should also be drilled at this time. The nature of these holes will depend upon the method of supporting the driven element. This will be discussed shortly, but will undoubtedly be pretty much an individual thing, depending upon the kind of junkbox or wallet available. Once these are drilled, the mast may be assembled to the supports with two bolts, such as ¼" carriage bolts. The mast and supports are then laid aside and the driven element construction is undertaken.

As may be seen from Fig. 1, the driven element is an ordinary dipole, although a folded dipole may be used if desired. If a folded dipole is used, the conductor ratio should be 1 to 1 for 300 ohm feedline. The dipole is made of ⅝ inch copper tubing which may be purchased at plumbing supply stores. For a support, I used a block of 2 x 2 about 5 inches long or so, and mounted an SO 239 connector on one side (see Fig. 3). Slots are cut in both sides and a ¼ inch hole is drilled through the center of the block. The ends of the block are drilled to a depth of about 2 inches with a drill bit slightly smaller than the OD of the dipole copper tubing so that the tubing will have to be forced into the holes. This makes a very rigid mount for the tubing. The SO239 connector should have a piece of copper wire soldered to the inner conductor before the connector is mounted on the block. Wood screws will make a good job of the connector mounting. The copper wire soldered to the inner connector is placed through the hole in the center of the block and then run down the slot on the opposite side of the block to one end of the block. A ground lug is placed under one of the wood screws which mount the connector, and a piece of copper wire soldered to



ASSEMBLY DETAIL
(Reflectors Omitted For Simplicity)

FIGURE 2

the ground lug. This wire runs down the slot on the connector side of the block to the other end of the block. Solder should be flowed over the ground lug and connector to insure a weathertight joint. Next, the copper tubing is forced into the holes in the ends of the block and the copper wires soldered to the tubing. The two pieces of copper tubing should be about 21 or 22 inches long so that they can be "pruned" for best match. If no SWR bridge is available, cut the tubing off so that the overall dipole length is about 38½ inches.

Two holes may now be drilled in the block as shown in Fig. 3 to pass stove bolts used for mounting the block to the mast (see Fig. 2). A coat of varnish should be applied to the block and solder joints at this time for weather protection.

All that now remains is to mount the dipole to the mast and insert all the reflectors into the supports, apply energy to the dipole through the feedline you intend to use and prune the dipole for best SWR using a bridge. An SWR of less than 1.2 to 1 should be easily obtained. In our case, the SWR was below 1.1 to 1 using a Johnson bridge. The antenna does not have to be on the tower when this pruning is done, but should be at least 4 or 5 feet off the ground. The shielding effect of the reflectors makes a simple job of this. Put it up in the air, and you are ready to go with a very fine antenna.

Several checks were run with this antenna at the same height as a commercial 10 element yagi, and signals were as good in *all* cases, and as much as 2 s-units better in some cases using the Corner. It is believed that this is attributed to the very low angle of radiation obtained with this antenna. Most people won't believe this, but comparisons show it to be true.

The real merit of this antenna is when it is used during contests. Just point it in the general direction you wish to work and *forget* about it. The front lobe is so broad that you can cover easily a 45 degree area in the front lobe with so little degradation that you will soon quit trying to "peak it up" on a signal. The front to back ratio, measured on a Collins receiver at about 20 miles distance is about 25 db, and there are no minor lobes which are stronger than the back lobe. It is just an all around excellent antenna, and at this QTH the yagi is a thing of the past. It was compared with a 50 element Long John Yagi at W8BPG and put up a good showing against the monster.

My most sincere thanks to K9HYV for the prodding it took to get this thing built, and for showing just how good an antenna can really be. Give it a try, and you will surely be as pleased as we are. CU on two.

. . . K9SGZ

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There are two main types of voltage regulators; the series regulator and the shunt regulator. These are shown in Fig. 1. The series regulator acts a a resistor which varies in inverse proportion to the load; the greater the demand on thet supply, the less the resistance of the regulator element. The series regulator, however, requires a device to sense a voltage difference in the output and apply this signal to the regulator element, and there is inherently more complex than the shunt type. The shunt regulator, on the other hand, has a single constant voltage drop across it, this voltage drop being the output voltage.

The regulator elements used in series regulators are of necessity vacuum tubes or transistors. In the shunt regulator, however, they may be either vacuum tubes, transistors, zener

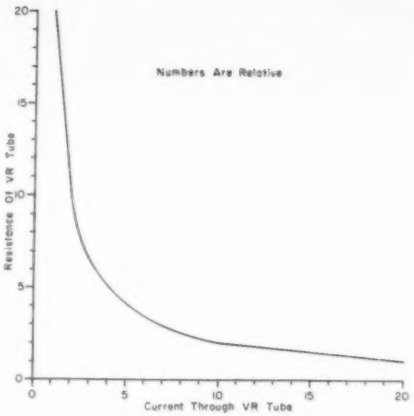

FIGURE 2

diodes or voltage-regulating tubes. The first two will still require a feedback system to sense changes in the output voltage, but the zener diode and the VR tube do not need this. Of these latter two regulating elements, the VR tube is best suited to power supplies for vacuum tubes, owing to its high voltage range and lower cost as compared to zener diodes of the same voltage.

VR tubes are diodes containing inert gases such as neon, krypton, xenon and argon to provide several voltage levels. When sufficient voltage is applied to the tube, the gas ionizes, and its resistance is inversely proportional to the current flow through the tube, as shown in Fig. 2. When ionized, VR tubes emit a soft glow, and this glow may be used as an indication of conduction. As you will see in the graph in Fig. 3, the current range over which the voltage is constant is limited, at its lower extremity by the loss of conduction, and at its upper by the transition to the abnormal glow and arc discharge stages, neither of which are suitable for voltage regulation.

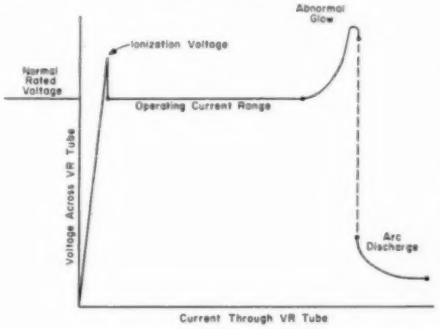

FIGURE 3

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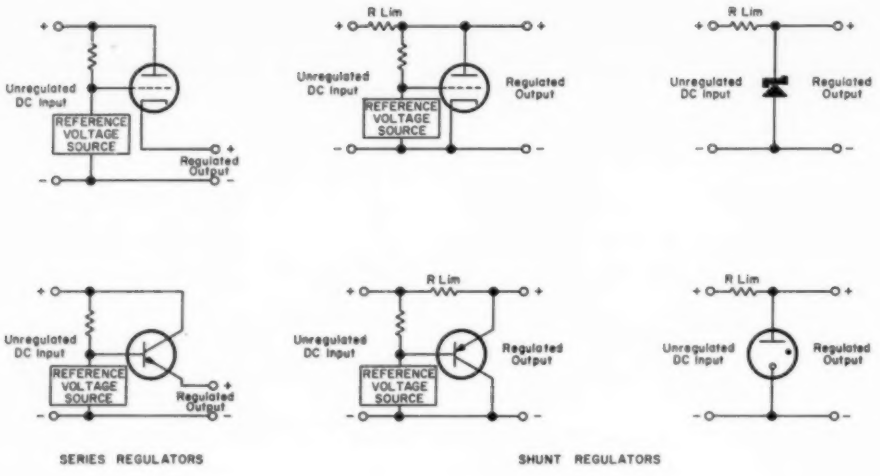

FIGURE 1

Since the resistance decreases as the current through the tube increases, it stands to reason that the current drawn through the tube would eventually build up to such a value as to destroy it. Therefore a limiting resistor is placed in series with the tube to hold the current to safe values. The value of this resistor may be calculated by the following equation: $R_{lim} = \frac{E_{sup} - E_{vr}}{I_{vr}}$ where E_{sup} is the supply voltage, E_{vr} is the rated VR tube voltage and I_{vr} is the maximum VR tube current. The limiting resistor may also be calculated for smaller values of VR tube current, the current being equal at least to the minimum VR tube current plus the maximum load current. Thus, when the load is drawing no current, the current through the VR tube will be equal to the minimum VR tube current plus the maximum load current, but when the load draws full current, the current through the VR tube is at the minimum required to maintain conduction. Obviously, the limiting resistor may be set so that the VR tube-load circuit draws the maximum current that the VR tube can handle, but it is not always necessary. VR tubes may also be used to regulate voltage at currents much greater than the tube can handle, provided that the load current *variation* does not exceed the rating of the tube. When using the tubes in this way, care must be taken not to disconnect the load while the circuit is on, or else the total load current will try to get through the tube, thereby destroying it.

As was seen in Fig. 3, the starting voltage is somewhat higher than the tube operating voltage. Also, the limiting resistor voltage drop makes it necessary to have the supply voltage somewhat higher than the operating voltage. Generally, the supply voltage should be about

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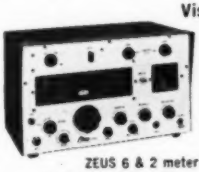

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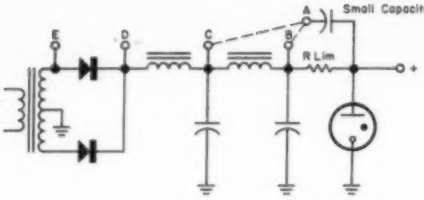

FIGURE 4

The small capacitor bypasses some of the ripple voltage (or surge voltage when supply is turned on) around the limiting resistor, thereby adding to the VR tube starting voltage. Obviously, the ripple voltage is highest at point "E." The capacitor will work even at point "B" under certain conditions.

As the "blank" pins of the tube protrude into the envelope, it is sometimes possible to connect the capacitor to these instead, thereby creating a supply of ions in the tube and making it easier to ignite.

1.3 times the VR tube voltage. At this point it might be mentioned that VR tubes are sensitive to light and radiation, and that a tube which will be used in the dark should be in the dark while its limiting resistor is adjusted, otherwise it may not start when placed in service. This fault may be overcome by giving a margin of safety in the choice of supply voltage. Nowadays many VR tubes have a bit of radioactive isotope inside which makes for more reliable starting. Also, in case of difficult starting due to insufficient supply voltage, some of the tricks shown in Fig. 4 may be used.

Fig. 5 shows the various types of VR tubes available. Type 5651 is generally used only as a voltage reference element in vacuum tube shunt or series regulators, as its voltage output is extremely stable, although the current is very low—in the neighborhood of 3 ma maximum. Type 90C1 is made by Mullard and Amperex, and is not as common as some of the others. The OC2 appears to be made only by Raytheon and RCA, while the others are generally available.

The VR tube has its own built-in safety interlock to prevent unregulated voltage from reaching the supplied circuit when the tube is out of its socket. As can be seen from the base diagrams in Fig. 5, the octal based VR tubes have a jumper between pins 3 and 7 which can be used to break either the AC power to the transformer or the DC supply to the tube itself. The latter is the better method if one is going to do a lot of experimenting with the rig, since the tube filaments do not go off when the VR tube is pulled. On the 7 pin miniature based VR tubes, each element has several pins connected to it. One simply connects the supply voltage to one pin and takes the regulated voltage from another. Then, when the tube is pulled, the supply voltage is cut off from the output.

Various VR tube circuits are shown in Fig. 6. In general these are self explanatory, but a few words of caution might be in order: do not forget that in a series string the supply voltage must be 1.3 times greater than the *total* of the VR tube voltages. Also, it should be noticed that all current that goes to the lower tubes must pass through the upper ones, and that therefore the total load current on the entire series string must not exceed the maximum current of any single tube (with the exception that the current drawn at the top of the string may be greater than the tube's maximum current provided that the maximum current variation does not exceed the difference between the maximum tube current and the current already being drawn by the rest of the load plus the minimum tube current).

For greater current handling capacity when the load current must vary over a range greater than that of the VR tube, tubes may be connected in parallel. To prevent one tube from getting all the current and thereby being destroyed, we have to insert current equalizing resistors of between 50 and 1000 or more ohms in series with each tube, as shown in Fig. 6. It must be recognized however, that the fixed equalizing resistors will have a varying voltage drop across them as the current through the tubes varies, and that the regula-

FIGURE 5

Type	Base	Minimum Supply Voltage	Operating Voltage	Operating Current Range	Approximate Price
OA2	A	185	150	5 - 30 MA	$1.45
6073*					
OA3/VR75	B	105	75	5 - 40 MA	$1.55
OB2	A	133	108	5 - 30 MA	$1.45
6074*					
OB3/VR90	B	125	90	5 - 40 MA	$1.65
OC2	A	105	75	5 - 30 MA	$1.50
OC3/VR105	B	135	105	5 - 40 MA	$1.50
OD3/VR150	B	185	150	5 - 40 MA	$1.45
90C1	A	125	90	1 - 40 MA	$2.25
5651	A	115	87	1.5 - 3.5 MA	$1.85

* Special rugged version

Fig. 5 — VR tubes available

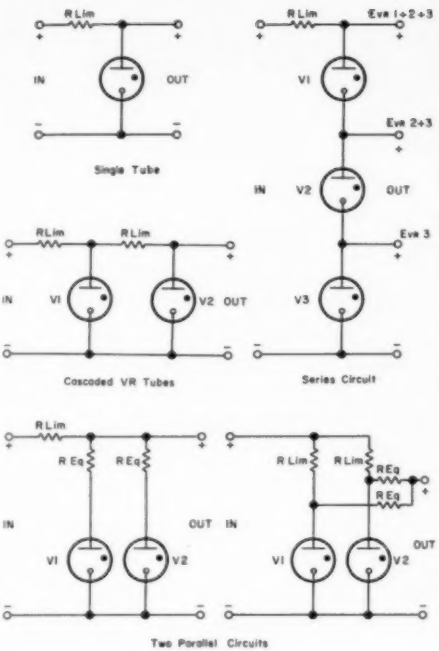

FIGURE 6

tion will not be as good as that of a single tube.

For greater stability, one may use the cascade circuit. In this circuit, the second VR tube obtains its supply voltage already regulated by the first tube. This means that the output tube is relieved of the necessity to regulate with respect to the varying supply voltage. It should be noted that the second limiting resistor *is* necessary. It should also be realized that the input tube has to have a higher voltage rating then the output tube in order that the latter may ignite.

All the VR tube circuits mentioned so far have been for equal to or greater than the rated voltage of the tubes. There is, however, a way to get low values of regulated voltage from VR tubes. This circuit, called the differential circuit, utilizes the difference in voltage between two different VR tubes, and is shown in Fig. 7. As you may notice, it's a variation of the cascade circuit mentioned above. The output voltage is taken from the top and bottom of the second stage limiting resistor, and may be as low as three volts. It should be pointed out that the second VR tube should have the lower operating voltage. It may be possible to get even lower than three volts by choosing two tubes of the same nominal volt-

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LOW INSERTION LOSS: Transceiver output to amplifier input, less than 1.02:1 SWR, 3 to 30 Mc. Amplifier output to antenna, less than 1.12:1 SWR, 3 to 30 Mc. The AR-1 requires 6.3VAC (6.3V jack on KWM-2) and normally open auxiliary contacts on the exciter relay. (ANT. RELAY jack on KWM-2). The AR-1 may also be used as a conventional antenna change-over relay. Size 3" X 4" X 4".

PRICE..... $32.50

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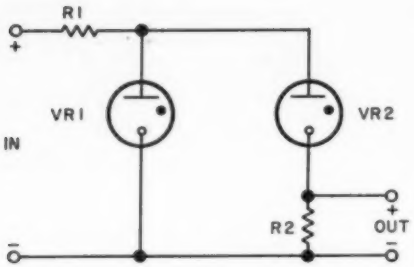

Differential Regulator

FIGURE 7

age rating, but with slightly different actual operating voltages. The formulas for determining the resistors are as follows:

$$R_1 = \frac{E_{sup} - E_{vr1}}{I_{vr1} + I_{vr2}} \quad \text{and:} \quad R_2 = \frac{E_{vr1} - E_{vr2}}{I_{vr2}}$$

While all the circuits shown in this article have the cathode at ground potential, there is no reason why one cannot have the anode at ground potential. This is, in fact, necessary when constructing a bias supply. Also, since the limiting resistor does nothing but limit current, it may be put between the cathode and ground, as well as between the anode and the supply voltage. When doing this, it must be remembered that the output voltage is taken from the top and bottom of the VR tube, *not* from the top of the VR tube and ground, and that the output voltage is isolated from ground by the limiting resistor and therefore cannot be grounded.

Like all things, VR tubes have some disadvantages. Probably the greatest of these is the lack of a great variety of standard voltages, such as are available with zener diodes. This is a minor grievance, however, when one considers the cost of a 100 volt zener capable of regulating voltage at a current of 40 ma. Therefore, until the price of zener diodes is brought down to earth, the VR tube is here to stay. When one realizes its limitations, it becomes a very useful device. . . . Lyman

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(W2NSD from page 4)

Rule Making

While I believe it would have been a lot more honest for the ARRL to have asked its members their opinion before they went ahead dictatorially and presented a petition to the FCC requesting sweeping changes in our regulations, I am more appreciative than ever of our democratic form of government which permits us all to have a say in this matter while the FCC is considering it and before it can be made into law.

It is always possible that the FCC may sit on this petition as they have many others in the past, however the political connections of ARRL President Hoover might well lubricate the normally sticky wheels of beaurocracy and surprise us.

I, for one, intend to oppose the ARRL position for a return to the old Class A system of licensing. While I agree with the ARRL that it would be beneficial for us to increase our technical knowledge standards, I disagree with their growing list of rationalizations for this and their Socialistic method of achieving it. It seems to me that they are tryng to get the government to legislate a cure for a difficulty that they are in a large measure responsible for.

Though I do not subscribe to the old saw that President Hoover led the U. S. into the Great Depression, I am seriously worried that Herb Jr. may be unwittingly leading amateur radio into a depression from which it may never recover. I cannot believe that the small group that is advising him have thought out the ramifictaions of their attempt to recapture the past.

RM-499

Though I'd like to print the QST petition to the FCC for restricted voice bands in its entirety for those readers who may not have read this long, tedious and predictable document, I won't because it goes on and on and on, filling over three pages of QST with mice-type. It is all there on pages 66 and following in the November QST.

After reading through all that marshmallow-like prose I had to go back and read it again in disbelief . . . sure enough, they never at any place gave any justification for their petition. They start out by quoting the FCC's regs, 12.0, Basis and Purpose. They inform the FCC that

(Turn to page 71)

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[1] "A New Approach to Receiver Front-End Design", W. K. Squires, W2PUL, QST, Sept. 1963. [2] "A Pre-I.F. Noise Silencer", *ibid.*, Oct. 1963.

SPECIFICATION PROFILE

- **Frequency Coverage:** 80 through 10 M (eight 500 kc. segments). Fixed tuned WWV at 10.0 and 15.0 MC; 5.0-5.5 MC auxiliary (WWV 5.0 MC). Two general coverage 500 kc segments
- **Selectivity:** 5 kc./2.5 kc./0.35 kc.
- **Stability:** Less than 500 cps warmup drift (typically in less than 5 min.); less than 100 cps thereafter including low to high line variation
- **Sensitivity:** ½ μv, or better, for 10 db S/N on 10 M with 5 kc. bandwidth
- **I.F. and Image Rejection:** Greater than 60 db
- **Cross Modulation:** Example: Receiving a **10** μv signal with 2.5 kc. selectivity, an unwanted **0.1 volt** signal 20 kc. away produces negligible cross modulation
- **Internal Spurious:** None at stated sensitivity
- **AGC:** Attack — 1 ms., **Slow** release — 1.0 sec., **Fast** release — 0.1 sec. Audio rise less than 2 db from 5 μv to 0.3 volt
- **ANL:** I.F. type; operates on AM, SSB, and CW
- **Size:** 7¾" H x 16¼" W x 13" D, 25 lb.

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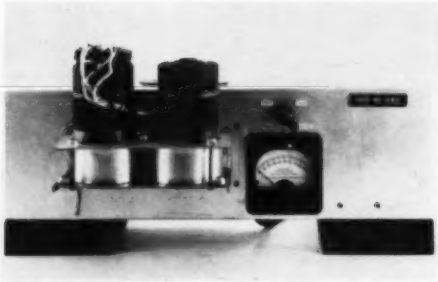
432mc Exciter from the ARC-27 RF Subassembly

Leroy May W5AJG/AF5AJG
9428 Hobart Street
Dallas 18, Texas
Photos by: Jim Dungan, KRLD, Dallas, Tex.



Front panel view of the Collins ARC-27 power amplifier subassembly. A small surplus double blower is mounted on the panel and blows air thru cut-outs to cool the tubes. The plate meter and its switch are shown.

Now that the RT-178/ARC-27 aircraft transmitter-receiver equipment is beginning to show in the surplus houses and junk yards, the UHF boys are beginning to make use of its innards. This compact unit was, and probably still is, widely used for air to ground communications in the region of from 225 mc to 399.9 mc. It was built by Collins and contains a veritable warehouse of UHF parts that will be eagerly snapped up by the 432 mc gang.

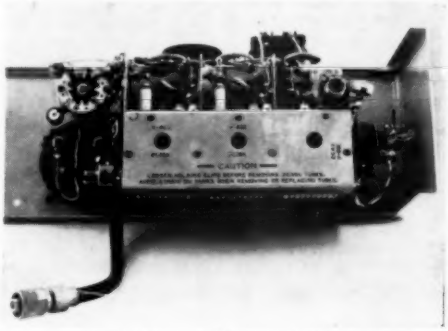
Since the frequency range will cover both the 220 mc and the 432 mc ham assignments, with just a bit of doing, portions of the unit can be used in various capacities in both these bands.

Here we will concern ourselves wtih the 432 mc transmitting portion of the equipment and a few words will be said regarding the modest modifications to be made to convert it into a very nice exciter or low powered driver for a larger 432 mc final, or even for use as a transmitter by itself on this band.

The Collins part number of the power-amplifier subassembly is 505-3506-006 and this assembly contains three tubes, namely, one 2C43, and two 2C39A's. Originally, the 2C43 was called an input-amplifier and accepted the drive from a so-called transmitting pre-amplifier. This particular stage worked on the final frequency, that is from 225 mc to 399.9 mc. This tube drove the driver, which in turn drove the power amplifier, both the latter two tubes being type 2C39A's.

The instruction book rates the output of the transmitter at 10 watts maximum and the minimum or lower limit at 2 watts. As amateurs, we can really beat the heck out of these figures, and not even cheat. Since we will be operating this particular version at a single frequency of 432 mc only, much greater power and efficiency may be obtained, since the original wide tuning range and need for constant power output efficiency is no longer a requirement.

This also means we can individually tune each stage, rather than the original gang tuning and make any other adjustments to peak up the output. Using a plate supply voltage of only 400, a power output of 22 watts can be achieved with all stages running practically



Rear panel view of Collins ARC-27 power amplifier assembly. Input stage at right and input coax shown. Output coax is at the left in the photo. A Jones plug at right also accepts the heater and plate voltage for the unit.

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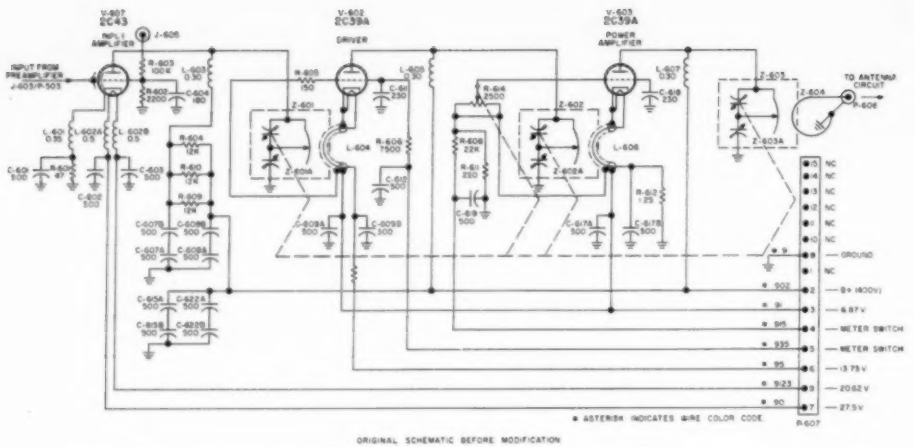


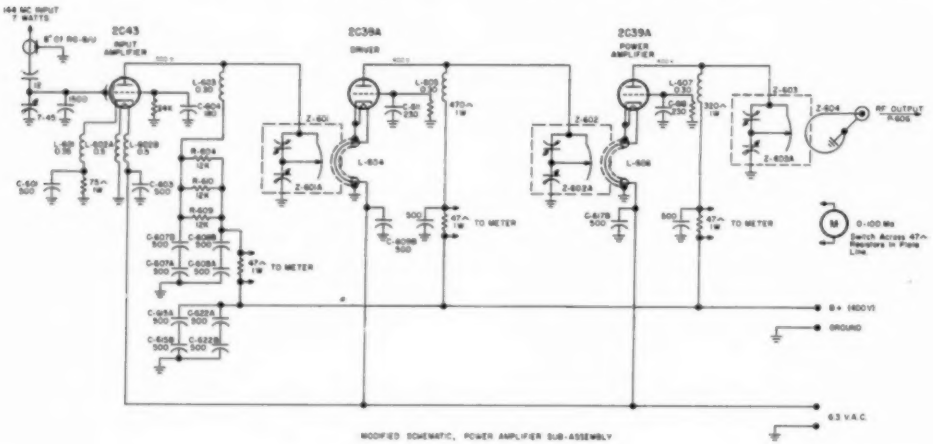
ORIGINAL SCHEMATIC BEFORE MODIFICATION

stone cold. Since the 2C39A tube is rated at a maximum plate voltage of around 1,000 volts and has a plate dissipation of 100 watts, we can then run the tubes in amateur fashion and it is not too much of a trick to obtain an output of as much as 50 or so watts, if one needs this much output power to drive the final stage.

At this station (W5AJG) we have pegged our unit at 40 watts input to the final 2C39A with a measured output of 22 watts. Under these rather lightly loaded conditions, the tubes have never been changed in many months' operation. This unit drives a couple of 4X150A's in push-pull for the final amplifier (modified surplus T-217A). Since the power limitation has been 50 watts input, this final has never been pushed to any extent, but since high-power is now legal on this band, the ARC-27 exciter is capable of driving this amplifier to at least 400 watts input, and perhaps more.

The modifications necessary to extend the already mentioned frequency upper limit of 399.9 mc to the desired 432 mc, and convert the input 2C43 tube to a slightly different function, are of minor nature and very little or no trouble should be encountered in this change.

First off—an UHF grid dip meter is just as valuable at 432 mc as at the HF's. Probably more so. If you do not have one, it is strongly recommended that you now acquire, borrow or build one. It will save a lot of grief in your 432 pranking and speed up your construction work immeasurably. Several of these ARC-27 rf decks are now in operation down in this territory and what little trouble was experienced in getting them going was directly due



MODIFIED SCHEMATIC, POWER AMPLIFIER SUB-ASSEMBLY

to the participants not having a GDO that will cover these frequencies.

Of course if you insist on not having an UHF GDO, this will not stop you from putting the unit on frequency, but it is a genuine pleasure to be able to fire up a modified unit and have it hit 432 mc in all its tanks, instead of 288 mc or some other odd multiple of which we are definitely not wanting any, thank you.

Modifications

To get started then, refer to the original circuit of this subassembly and compare it with the modified circuit. It can be seen right off that the heater voltage for the tubes is changed from the ARC-27 way to the more conventional 6.3vac ham way. Next, the bottom end of the cathode input tanks, L-604 and L-606 are grounded with as short a strap of copper material as is possible and as direct to the chassis as is possible. Do a good job here. After these changes, the heaters will receive the proper voltages.

The three tube output tank circuits will be tackled next. These ingenious devices are known as Hubbard tanks, and due to their construction, a very wide frequency range is possible. These are the units we wish to extend to 432 mc from their previous top limit of 399.9 mc. Now, altho all these units look like two peas in a pod, it appears that when attempts are made to extend their frequency, some units respond better than others. This is where the GDO is worth its weight in gold. You simply can not tell just by looking. If your unit does not reach as high as 432 mc, it will be necessary to operate on the several sectors of the rotor of the tuning capacitors. These sectors of the rotor can be bent back, or entirely removed until such a time as the GDO indicates that you have reached 432 mc. Some units will require bending, some complete elimination of several sectors and some no change at all. The trimmer capacitors associated with these three transmitting tanks consists of a brass slug adjustable towards a cup to increase capacitance and away from the cup to decrease it. These are really temperature compensating capacitors and range from 1.5 to 2.5 mmfd in value. They were meant to operate in such a way as to physically compensate for any changes brought about by temperature variations, reducing tuner detuning considerably. In an aircraft, these units were completely bottled up and were operated at different altitudes and temperatures. As used in our work and with a blower on the tubes, no detuning is detectable and these particular compensating capacitors are not even

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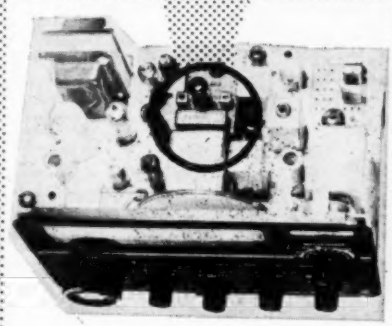

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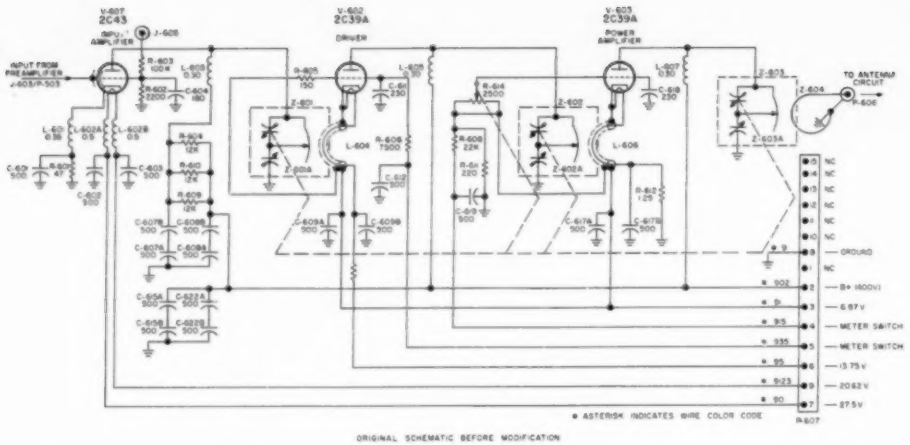

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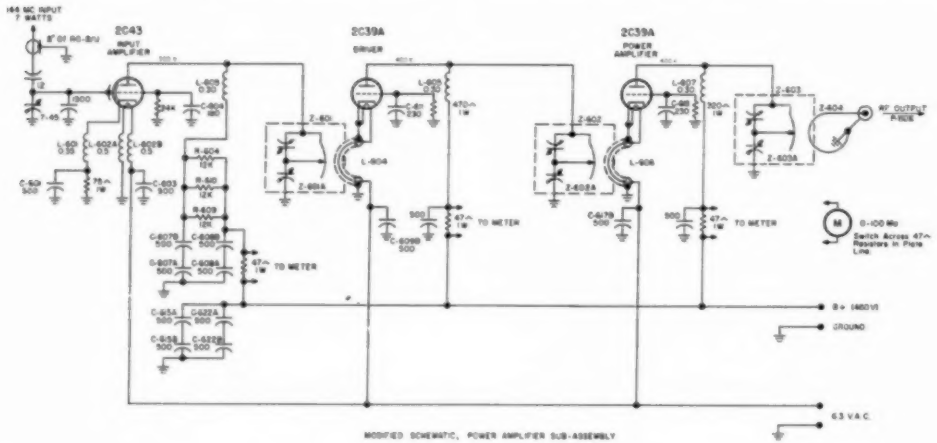

MODIFIED SCHEMATIC, POWER AMPLIFIER SUB-ASSEMBLY

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Modifications

To get started then, refer to the original circuit of this subassembly and compare it with the modified circuit. It can be seen right off that the heater voltage for the tubes is changed from the ARC-27 way to the more conventional 6.3vac ham way. Next, the bottom end of the cathode input tanks, L-604 and L-606 are grounded with as short a strap of copper material as is possible and as direct to the chassis as is possible. Do a good job here. After these changes, the heaters will receive the proper voltages.

The three tube output tank circuits will be tackled next. These ingenious devices are known as Hubbard tanks, and due to their construction, a very wide frequency range is possible. These are the units we wish to extend to 432 mc from their previous top limit of 399.9 mc. Now, altho all these units look like two peas in a pod, it appears that when attempts are made to extend their frequency, some units respond better than others. This is where the GDO is worth its weight in gold. You simply can not tell just by looking. If your unit does not reach as high as 432 mc, it will be necessary to operate on the several sectors of the rotor of the tuning capacitors. These sectors of the rotor can be bent back, or entirely removed until such a time as the GDO indicates that you have reached 432 mc. Some units will require bending, some complete elimination of several sectors and some no change at all. The trimmer capacitors associated with these three transmitting tanks consists of a brass slug adjustable towards a cup to increase capacitance and away from the cup to decrease it. These are really temperature compensating capacitors and range from 1.5 to 2.5 mmfd in value. They were meant to operate in such a way as to physically compensate for any changes brought about by temperature variations, reducing tuner detuning considerably. In an aircraft, these units were completely bottled up and were operated at different altitudes and temperatures. As used in our work and with a blower on the tubes, no detuning is detectable and these particular compensating capacitors are not even

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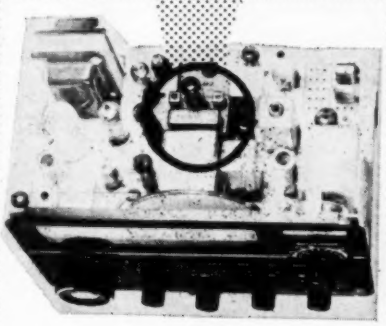

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necessary. They may even be removed if you wish. Just make the tanks resonate on 432 mc with the GDO and there will be no sweat.

With the heaters of the tubes taken care of as well as having the tanks on frequency, the remainder of the modifications are simple and will be described stage by stage in turn.

2C43 Input Stage

This is a grounded grid, cathode driven input stage using a 2C43 type tube. We must now make a decision as to what frequency we will drive into the tube. It will be very flexible and you can go any route that will best fit your particular requirements. They will all work very well.

Most will desire to use the 2C43 stage as a tripler from 144 mc. However, some will elect to use the tube as a doubler from 216 mc, and a few will probably choose to use the stage as a straight through amplifier on 432 mc. This latter arrangement is perfectly sound if one already has a few watts of 432 mc energy available and wishes to use it.

Since the plate tank of this input tube is always at 432 mc, then it will merely become a choice as to its input and the only thing one will have to do is to select the proper size of rf chokes to be used in the heaters and cathode of the 2C43 tube. Actually, the rf chokes as originally installed are designed to range the frequency of from 225 mc to 399.9 mc and will work very well as is. As the original diagram shows, these are values of from .35 to .50 μh windings. Very often though, these Collins rf decks as picked up from the bare ground at various junkyards are minus the 2C43 socket which will contain certain components, including the rf chokes. (We refer here to the octal socket.)

In such a case, it is suggested that rf chokes of the desired driving input frequency be used. For example, if one desires to make a tripler of the first stage, then chokes of the Ohmite Z-144 type (1.8 μh) should be used. Should the stage be employed as a doubler from 216 mc, then type Z-235 (.84 μh) should be used, and finally if the stage is to be used as a straight through 432 mc amplifier, then Z-460 types (.2 μh) would be used.

For tripling service a new cathode resistor of 75 ohms is substituted for the original 47 ohm value. This was found to work well in tripling service. A new grid leak resistor of 24K is substituted for the original 2.2K. This also helps the tripling efficiency. The plate dropping resistors should work as is and the final desired voltage at the plate of the 2C43 tripler should be 300 volts. This will result in 18 to 25 mils of plate current. Grid current derived from the 144 mc drive to the tube should show at least 2.8 ma or more. Grid voltage as measured with the unit fully operational was found to be around 67 volts dc. Cathode voltage checked 1.4 v. If desired, a 47 ohm, 1 watt resistor may be inserted in the +B line to this stage and a meter switched across it to measure plate current.

A word about the input matching. The modified circuit shown assumes tripler operation from 144 mc. A driver with 7 watts output is used here. One of 5 watts will probably get by, if the coupling circuit efficiency is good, but at least 7 watts should be available for a bit of reserve with aging tubes. With the coupling coax (RG-8/U) about 8 inches in length, the arrangement as shown of capacitor matching works very well. Should the length of coax be something very much different from this value, it is possible that experimentation with the value of the 1500 mmfd capacitor would be advisable. Merely adjust for maximum rectified grid current in the 2C43 grid circuit.

2C39A Driver Stage

Changes on this stage consist of eliminating R605, R606, R613, C609A and C612. A new grid leak resistor of 470 ohms is substituted for the original one of 7.5K. Another 47 ohm resistor may be inserted in the B lead to measure plate current. A 500 mmfd by-pass should be used on the top side of this sampling resistor.

The values that should be encountered on this stage would be about 45 ma plate current—grid current of about 5.5 ma at the minimum and a developed grid voltage of about 2.6 vdc. That's all.

2C39A Final Power Amplifier Stage

Eliminate R608, R611, R614, R612 and C617A and C619. A new value grid leak resistor of 320 ohms, 1 watt, should be placed across the capacitor C-618. This stage may also employ a 47 ohm, 1 watt, sampling resistor in its B lead to measure plate current. An 0-100 ma meter may be shunted across any of the three stages to read plate current.

This stage should show about 100 ma of plate current when loaded and with a supply voltage of 400vdc. The grid current will measure about 37.5 ma and a developed grid voltage of about 12 volts should be observed.

This will represent a dc input to this stage of 40 watts and with a commercial 52 ohm watt meter good to 1,000 mc, 22 watts was indicated. By increasing the plate voltage on the final 2C39 and juggling the grid resistor

a bit, an output of 50 watts is easily achieved, although the tube life under this type operation is not known. Under the 22 watt output type operation, the tubes should last practically forever. At least they have been operating over two years at this time and no changes have been necessary or made.

Air is required on the tubes and some sort of a small blower system is necessary. The photo shows one way of doing it by mounting the blowers on the front panel and blowing thru two panel opening. Any other scheme will be OK. Suit yourself.

Several stations around this area are now using this converted ARC-27 unit including W5SWV, W5NU, W5HPT, K5JHG and W5AJG. All stations report smooth operation.

Of course, these units will cross 220 mc also and if used for this frequency, no changes should be necessary on the Hubbard tanks. However, unless one is fortunate enough to possess more than one of these units, it seems a bit of a sacrilege to use such a gizmo on 220 mc, when its main worth would be for 432 mc operation.

So use it on 432 preferably—220 mc if you must, but in any event, watch that undesired 288 mc output (second harmonic of 144 mc drive). It is still hot as a pistol on this frequency and can get you in trouble if you are not watchful. Use the GDO, or lacking that, the absorption wave meter to be sure each stage is on the right 432 mc frequency.

. . . W5AJG

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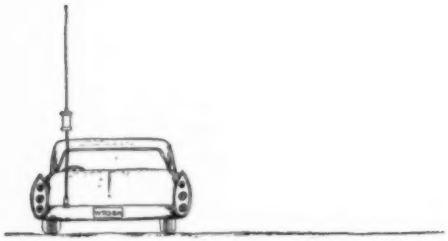

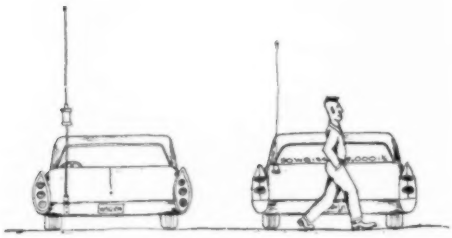

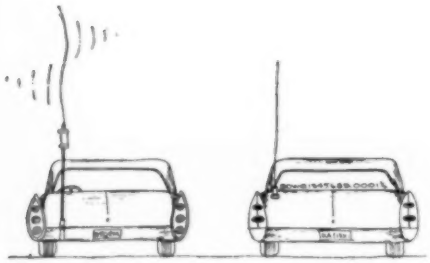

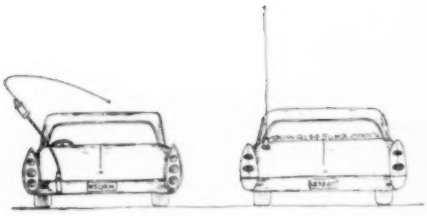

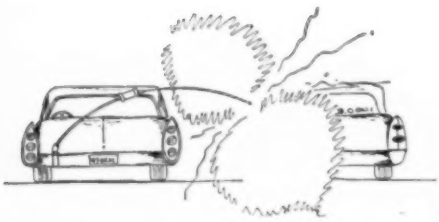

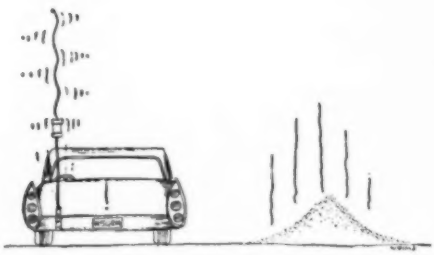

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So, how to get rid of radar and still copy signals? Well, we did it. It works like a charm. Then, after cleaning up all that noise we got to mulling the gadget over and decided to give it a try on ignition noise. Hmmm, wiped that out too.

All of a sudden it struck us what we had done. Ignition noise wiped out and without the usual ruination of the signal that noise limiters produce. Good grief, just think what a boon this would be to all of the sideband mobile transceivers! We started looking over all the info on transceivers and decided that we could make little plug-in noise blankers for them which would sell for around $60 (like probably $69.99, hi!). We'll announce models for the various transceivers as we develop them. We'll also have some for the VHF gang for radar and ignition removal. The 160 meter group will finally be able to work right through all that loran.

In the meanwhile we are still building the finest VHF converters known to man. For a piddling (?) $98.50 we will make a custom built converter for you for 50, 144 or 220 mc. You tell us what i-f output you want or what receiver you are using and we'll take it from there. The Power supply for this gadget, if you don't want to make do with your receiver supply, is another $60. We hate to price it so high, but we've thrown everything we could think of into it to give you the last word in results.

Only a few DX nuts really need that expensive DGC model converter. For everyone else we are making the best low priced converter on the market, our HJC model. The HJC-50 for six meters is only $31.95 (14-18 mc output) and the matching power supply (plugs right in) is $9.95. The HJC-144 (14-18 mc output) is $49.95 with built-in power supply.

Considerable interest has been shown in our not yet announced VHF triplers. These gadgets take up to 50 watts of 144 mc rf and triple it to 432 mc with about 15 watts output. A UHF tripler can then be added to the lineup to give 1296 mc output on the order of 5 watts. We expect to have these triplers in production shortly at a price of $59.50.

As we get into making the aforementioned noise blankers we will have to slow down or stop making our extremely time consuming DGC converters, so don't put off your orders too long. Delivery on these units is now about six weeks.

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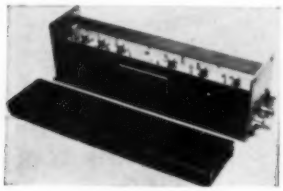

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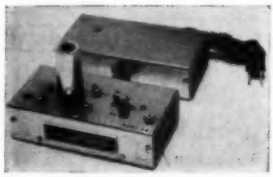

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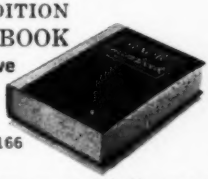

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Sideband Linears

One of the first items mentioned, when anyone talks about sideband, is a "linear." You probably already have figured out that he's referring to a "linear amplifier"—but you may not know why it's so important.

As mentioned earlier in this series, sideband is different than AM. The biggest difference is that sideband consists of the *actual* voice waveform, transposed to a frequency up in the rf region.

And since it *is* an exact replica of the voice waveform, obviously any amplifier used to boost the power fed to the antenna must do its amplifying without distorting the signal in any way.

And really, that's all a "linear" is—an amplifier which amplifies without distorting.

The name "linear" is a bit of engineeringese which has crept into the ham vocabulary; it refers, originally, to the graph of input voltage versus output voltage of the amplifier. Fig. 1 shows a typical example. So long as this graph is a straight *line*, the response is said to be *linear;* when it begins to curve for any reason so that output is no longer exactly like input only more so, it is called non-linear.

FIGURE 1

Typical linearity graph

The amplifier whose graph is shown in Fig. 1's linear up to point A; from this point on, it is non-linear.

This illustrates very neatly the fact that any "linear" amplifier is that only up to a point; trying to get more out of it, once you reach that point, only gets you trouble instead. But more on that later, in its proper place.

Now that we've established *why* is a linear and, by implication, *what* is a linear, let's take a little closer look at exactly what a linear is.

We already said that a linear is any amplifier which does not distort. We all use them every day; any audio amplifier has to be pretty linear for us to tolerate it. In addition, the rf and *if* stages of your receiver are also linears—at least, up to the overload point. And if you want to find out firsthand what an overloaded linear sounds like, then switch your avc to "manual", turn the rf gain wide open, and tune to one of the "60-over-9" local signals. The resulting mess coming out of the speaker will etch the difference between a good linear and a non-linear "linear" (or an overloaded one) permanently into your brain!

But what, you may ask, does a linear's circuit look like?

The answer is that it *can* look like any other rf amplifier circuit; the secret of linear operation is in the specific voltages you apply to the tube rather than in the circuit arrangement. There are a few exceptions to this rule, and we'll look at them a little later, but it holds true most of the time.

We already mentioned audio and receiver rf-*if* amplifiers as typical linear amplifiers; these are, for the most part, class A circuits.

Much confusion has been generated by the letter classification of circuit operating condi-

tions; we'll define "class A" for this series as being that set of conditions in which plate current flows at all times. This is the easiest set of conditions to operate under, but also is the least efficient.

For instance, typical efficiency of a class A circuit is about 25 percent. That means for 10 watts in, you'll get about 2½ watts out.

At power levels below about 3 watts out, this is usually of little consequence. As a result most sideband *driver* amplifier stages (those operating at low power levels) use a class A circuit.. But when it comes to putting 400 watts in to get only 100 out—or having to settle for 250 watts into the antenna at the legal limit!—the class A configuration usually goes by the boards.

Next step up the efficiency ladder is the class B circuit; for our purposes, this is one in which plate flows *exactly* half the time.

Theoretical efficiency of a class B amplifier is 78½ percent; in practice, you can expect about 60 percent.

In audio use, a class B amplifier requires two tubes and they must be connected in push-pull. This is so because the class B circuit amplifies only one-half of each cycle of incoming signal.

However, at rf, a single tube may be used; alternately, two tubes can be run in parallel. This is possible because the input and output tank circuits act as flywheels and supply the missing half-cycles; no one ever knows the difference.

Since the class B circuit is a little more complicated than the class A (it requires some driving power), it is seldom used where a class A circuit can be used in its place. When you need more than about 3 watts output, though, it can be and has been used well. Tubes are available which will take up to the legal limit (and more) in class B service.

But we said a little earlier that true class B means plate current flows exactly half the time. With most available tubes (we know of no exceptions, but hesitate to make a flat statement), operation in true class B produces excessive distortion of a most unpleasant kind.

In audio, it's called "crossover distortion" and no more descriptive name could be found; it's caused by the tube's cutting on and off every half-cycle.

The effect can be minimized by allowing *some* plate current to flow even when the tube is producing no output. This is a cross between classes A and B, and is known as class AB operation.

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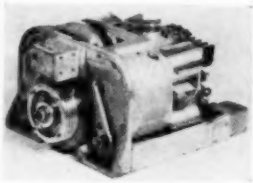

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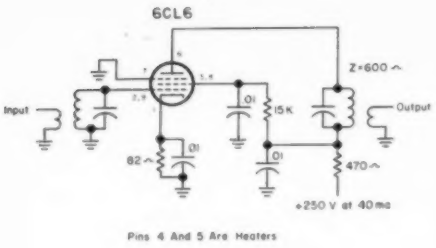

FIGURE 2

Class A 4 watt linear

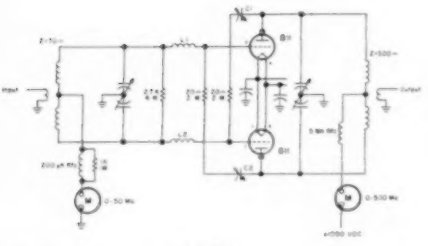

FIGURE 3

Class B linear using 811's
L1, L2, — 9 turns #12, 1½" dia., 1¼" long
C1, C2, — Bud type NC-853 neutralizing capacitors

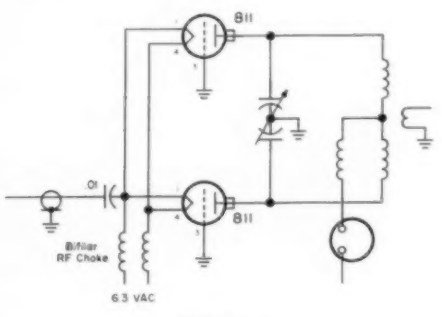

FIGURE 4

811 G-G class B linear, all plate components same as Fig. 3

Class AB operation is the most common kind; it is further subdivided into two subclasses: AB1 and AB2. In AB1, as in class A, the control grid never draws any current. This means that no driving power is required, and consequently the driver stage need not be so bulky.

In AB2, as in class B, grid current flows on positive peaks of incoming signal but not on negative peaks. This means that some driving power is required, and also means that the driver stage will see a load that varies during the cycle from a relatively high value to almost nothing al all.

Efficiencies of AB1 and AB2 both compare to those of class B. Exact figures depend on too many variables to be quoted, but in practice the 60 percent won't be far off. Like class B, these may run up to and beyond the legal limit.

But there's still another class of amplifiers, class C. What about this one?

Most people will tell you offhand that a class C amplifier cannot be linear. However, quite a few "class C linears" have been built and used by people who refused to believe what they heard.

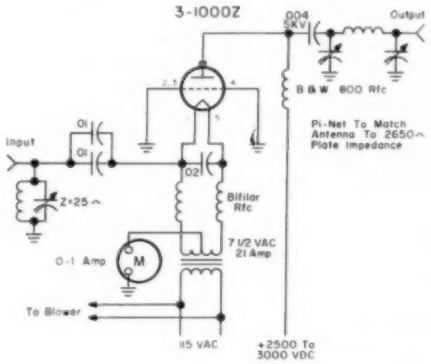

FIGURE 5

3-1000Z 2 KW PEP linear

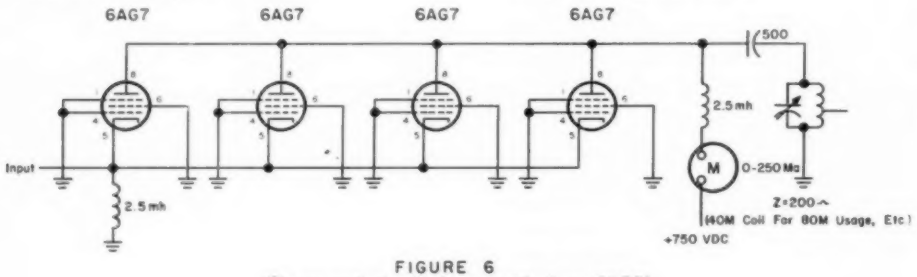

FIGURE 6

Cheap and simple linear with four 6AG7's

This type of amplifier is an exception to the rule cited earlier that linearity does not depend on the circuit. It's also known as the "ZL linear" and the circuit is the key to its success. We'll look at it in detail when we get to that stage in typical circuits.

Speaking of typical circuits, let's look at a few, in the same order we went through the classes.

Fig. 2 shows a typical class A linear. Note that tank circuit values are not given in C and L but are, instead, in ohms of reactance. This allows you to use this circuit at any frequency by simply figuring out how much C provides this many ohms and dipping the coil to resonate with the resulting C value.

This class A linear uses a type 6CL6 tube, and is good for up to about 4 watts output with the voltages listed. For lower power use, take the typical receiver *if* schematic from any issue of the ARRL manual and use it with 6BA6 or similar tubes.

A typical class B linear using a pair of 811's and capable of giving peak-power outputs up to 400 watts is shown in Fig. 3. It requires about 10 watts of drive for maximum output, and so cannot simply be tied on behind the 4-watt unit of Fig. 2.

Note that cross-neutralization is employed in the circuit of Fig. 3. Since 811's and similar zero-bias tubes offer many advantages for sideband, experimenters looked around for a good way to avoid the need for neutralization. They came up with the grounded-grid circuit, shown in Fig. 4.

Output of this circuit is essentially the same as that of the circuit of Fig. 3, but drive requirements are now in the neighborhood of 50 watts. Most of this power is fed straight through the amplifier to appear in the output, however.

As more and more medium-power commercial exciters came on the market, the power-gulping qualities of the g-g circuit became more popular, until specially designed grounded-grid tubes such as the 3-400Z, 3-1000Z, and PL-6569 were made available. Any of these tubes may be driven to the legal limit by 65 watts or less from the exciter. A circuit suitable for use with a 3-1000Z is shown in Fig. 5.

One of the more popular circuits before the high-power rush appeared—and one still popular among the QRP gang—used four type 6AG7's in grounded-grid. It was simple, inexpensive, and could really perform. First described by W6GEG some years ago, it has been expounded upon at length by Ed Mariner. The circuit appears in Fig. 6; with

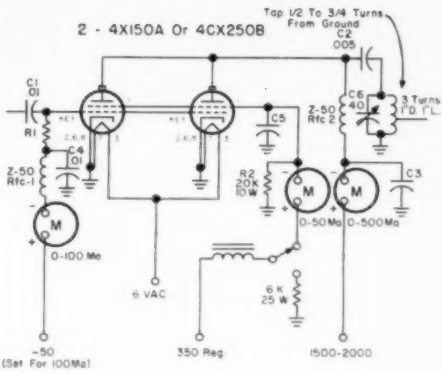

FIGURE 7

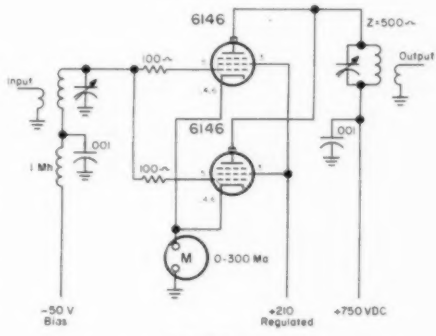

FIGURE 8

Dual 6146 linear capable of 120 watts

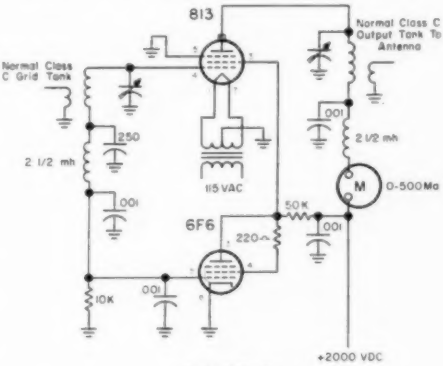

FIGURE 9

PEP output ZL linear using 813; 6L6 will sub for 6F6

6AG7's, this will give 150 watts PEP which is a highly respectable signal.

Going back to the class B (conventional) circuit of Fig. 3, you'll note the swamping resistor across the grid tank. This is necessary

to make the driver stage see approximately the same load at all times. The grounded-grid versions, because of their extraordinarily low input impedance, requiring no swamping.

Another way, of course, to eliminate the problems of swamping is to operate class AB1. Almost all class AB1 linears use beam power tubes since they are capable of large output power with little drive.

A typical circuit using the 4X250B appears in Fig. 7. With proper tank circuits, this circuit is usable to 500 mc (provided the right impedance values appear at the plate and the output).

A less exotic version, still good to about 60 mc with 120 watts PEP, is the double-6146 rig shown schematically in Fig. 8. This is typical of possibly the majority of today's medium-power linear circuits, with some variation of voltages.

In all AB1 linears, it's best to adjust the bias voltage so that the tubes are running at about 1/3 of their total rated dissipation with no input signal applied. These values are indicated on Fig. 7 and 8. Then, after tuning up and running a linearity check, it can be adjusted slightly for best possible linearity.

A spell back there, we promised a detailed look at the ZL linear. The circuit is shown in Fig. 9; in operation, this is a sort of "screen-moduated" linear. The 813 is operated class C. However, the amount of screen voltage it has to work with from instant to instant is determined by the amplitude of the incoming signal, and with proper adjustment this "screen-modulation" process can be made to reproduce the output signal as an exact replica of the input, only bigger. And that, by definition, is a linear!

The 6L6 is more of a clamp-tube modulator in this circuit than it is anything else; linearity of the circuit is determined primarily by the linearity of the 6L6. With parts values as specified, it should work nicely. Experimentation with voltages or values is at your own risk!

This about rounds up the subject of linears as well as it even can be in the pages of a single magazine issue. To be complete, we would have to show circuits using every different type of transmitting tube in every possible configuration—and this would run to hundreds of pages! Just remember that it's the operating conditions, rather than the circuit, which make a linear work right, and you'll have no trouble.

We haven't touched much on designing your own linear; that's almost a book in itself, and a number of excellent articles on the subject are already in print. Several of them are listed in the references below.

And the tuneup procedure, which has been known to scare many potential sidebanders? That's part of the subject of the next installment!

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Barney and the ZDO

Sylvia Margolis
95 Collinwood Gardens
Ilford, Essex, England

There's something about DX-mania that makes a man mean.

I've seen friends of thirty years pass each other on the street without a word, because of some DX-rivalry. I've seen a big, amiable guy turn childish and petty and spiteful if he can thereby get that rare QSL. I've see decent citizens stoop to all kinds of chicanery to put one over on the rest of the gang and rational, sensible, kindly Dr. Jekyll's turn into ruthless,

hysterical Mr. Hyde's at the mention of a long-sought call. What they can see in it all beats me. The contact is brief and brutal—exchange of reports, through that insane QRM, and it's the turn of the next sheep after a sheepskin.

In our town we do go after the DX occasionally, just for kicks, but we try not to lose our sense of proportion over it. And we always hunt in a pack, for we know that it's useless expending all that power QRM'ing each other—rather work together and achieve something—if, indeed, it's even worth the fight. If there's something rare in the offing, then we call each other up on the landline, no matter what time of night or day, and we share the spoils, so to speak. That's where poor Barney went wrong when he kept the PK4 to himself.

It all began when the old Billiter place, which had been up for sale ever since any of us could remember, suddenly swarmed with builders, landscape gardeners and interior decorators. Obviously there was big money at work, for the fine old house on the hill soon bloomed again under their ministrations. Then one day I got an urgent call at my office from Bob, our local Police Chief, whose own house had a clear view of the hill. "Bill," he said, excitedly, "take a look out of your south-west window and tell me if you can see what I can see."

When a cop tells you to take a look you take a look, even if he is a life-long friend and first-class operator. There, blossoming in all its dollar-laden glory, soared the biggest and lushest antenna array I had ever seen. It was one of *us* who had arrived in town.

Barney soon made himself known at our Radio Club and a nicer guy you couldn't hope to meet. He had retired from business, and very nicely too, if the way he had refurbished and refurnished the old house was any yardstick. His wife was up to standard, too. Several years younger than her adoring spouse, Evelina was a DISH, if you like your dishes empty. Her clothes came from Paris, her shoes from Rome; her furs looked better on her than they did on the original chinchillas; her diamonds came from THAT store in New York. We guys just used to bask in the glory of those huge blue orbs and have quite surprising dreams about the long, silver-blonde hair, which she drove thirty miles twice weekly into the city to have dressed into yet more perfect elegance. Dream was all we did, though, for Barney was a very big man and worshipped his Evelina. She accepted his adoration and our homage in a kind of dreamy daze and with almost complete silence. Evelina rarely spoke and if she did it was to let such precious

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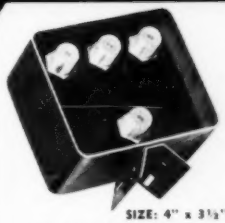

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pearls drop from those sculptured lips as:—
"Kinda hot today."
or
"Cream or sugar?"

A perfect woman.

Barney was very wealthy indeed, yet you couldn't find a more kindly or generous man anywhere in the Callbook. I was proud to call him my friend—up to a point!

For Barney had that terrible blind spot—DX-mania. Mention a rare call that was due on the air and the bluff face would go sort of tight and quiet, the clear eyes cloud with secrecy and deception. Not that he wouldn't share the goodies life had brought him. When one of the Radio Club had some financial bad luck, it was Barney who made up the deficit out of his own pocket. Barney helped to equip a disabled local radio amateur. When we wanted to establish a yearly scholarship to send high school kids to college to study electronics, Barney headed the subscription list.

But let it be known on the tomtoms that a KP6 was due, or that there was a chance of a HKØ, and it was every man for himself. With his superb commercial gear, hilltop QTH and that dreamy antenna, Barney was more man than any of us.

To Barney, the lovely Evelina was the sun and the moon. But his stars were his DX-score, which he toted up zealously at each addition and jealously compared with top operators all over the world.

It was the PK4 that did it. Nobody except Barney knew there was to be a station on Sumatra until Barney had worked him and the station had departed.

Every Thursday night we would meet at Barney's for a regular ragchew. This took place in the palatial basement, with its air conditioning and wall-to-wall carpeting, which he democratically called a "shack." Beer flowed with Barney's customary lavishness and the air became thick with the smoke of his cigars. Then he casually displayed the brilliantly coloured QSL, with the strip of exotic stamps proclaiming without doubt its horrid authenticity.

"Gee, fellers," boomed Barney, in his most regular-guy manner, "I'm that peeved I didn't call you up and tell you he was on. I just guessed you would have known all about it!"

Not that we really cared about the PK4. It was just the tricky way he had fooled us that set the fuse.

One thing Barney had never worked was a ZDØ. From time to time rumour had it that an expedition was to go to Claney Island, but the remote and unhospitable rocky islet in the South Atlantic, whose terrain and climate made even Tristan look inviting, did little to attract those intrepid adventurers whose whole existence seems to be devoted to letting a little sunshine into the lives of stop-at-home DX fiends. The call ZDØ was a DX joke, a sort of DX Eldorado, the pot of gold at the end of the rainbow, fourteen hundred miles south of St. Helena.

So when the news came that a Scotsman on a world anthropological survey, was to spend a few hours on Claney, just between tides, and that the blessed Scotsman was also a radio amateur, the DX world was in ferment ZDØAA was to be in business.

Those tough, remorseless, hard-eyed babes to whom amateur radio was now reduced to months of mere listening, without saying one word, waiting to pounce the moment the sought-after call came through, were girding up their loins—and their linears.

Was it my fault that my own dear and faithful wife, Janet, had persuaded Evelina to try a new hairdresser in the city that day? Or that Janet had managed to drum it into the exquisite vacuum that served Evelina for a head to keep the venture a dead secret from Barney, so that his delight in her enhanced tresses should be even greater because of the big surprise?

The girls left early that morning for the city in Evelina's snazzy new Italian roadster. The maid served Barney's lunch, but he was so busy checking and testing his rig all day that it wasn't until early evening that he noticed that the loveliest ornament in his establishment was missing. Even then he wasn't too worried. Evelina loved to shop. Indeed most of her extensive spare time was spent in searching for even more items to add to her fabulous wardrobe, or more gew-gaws for the house on the hill. Evelina would soon be home, burbling over some pricey new acquisition, like a child with a new toy.

When the girls came out of the coiffeur's sumptuous salon, it was evening and raining heavily. Imagine their distress when no amount of coaxing would persuade Evelina's car to start. They were stranded in the big city. Janet swore afterwards that she tried and tried to rent a car and to call Barney, to save Evelina from unnatural mental effort. She called me and I tried to call Barney, but he had taken the phone from the hook, a thing he would do to ensure unbroken peace when something important was on the air.

Evelina and Janet were comfortably settled in a hotel in the city when Barney really began

to worry. He questioned the servants and called the Country Club, where she might have dropped in for a cocktail and been stranded by the downpour. Then he called Bob, in his official capacity. The Chief of Police promised to keep a sharp lookout for a tiny, low-slung Italian drop-head and to let Barney know the moment news came in, whether it be good or . . . . the frantic Barney slammed down the phone and rushed out to his own big sedan. Bob went straight back to his own rig to work the ZDØ, who was due to come up any minute. Bob had been one of those who had missed the PK4.

Barney spent most of that night looking for the wandering Evelina, searching the black, wet countryside, with heaven knows what dire thoughts of younger men, even wealthier men, men who could offer her more furs, diamonds and European cars than he could. Meanwhile the precious few hours of the ZDØ sifted away.

Next morning Evelina returned in the revived roadster, a very lovely strawberry blonde Evelina, with lavender highlights. It was never quite decided just what it was that had troubled the Italian car. Of course, the garage where Evelina always parks it on her ritual visits to the City, is owned by a cousin of Fred, who was another of those who didn't work the PK4.

Many years will elapse before anyone as tough as the anthropological Scotsman braves the terrors of Claney Island to put ZDØ on the map once more. The card is quite simple, but obviously authentic. It seems a shame that a big, lovable guy like Barney should have missed such a momentous QSO and not be able to add yet another rare call to his list.

But, as I said before, DX-mania makes men very mean, very mean indeed.

Antenna Fact and Fiction

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St. Petersburg 33, Fla.

The explosive increase in ham-band occupancy has brought tremendous changes to our hobby during the past 15 years. One of the most obvious is the availability and use of directive, rotable "beam" antennas. Nowadays the latest in commercial beams is within the reach of almost everyone's modern credit plan. Unfortunately, it is not easy to precisely determine (either by calculation or by measurement) the performance parameters of an antenna, even in the (unusual) case where installation and/or environmental factors can be closely controlled. Because meaningful direct measurements and relative comparisons are beyond the means of most hams, and because of the competitive nature of the business, claims of many authors and advertisers have traditionally tended toward the overly optimistic.

For the ham desiring a better feel for what transpires twixt his transmitter output and somebody else's receiver input, several detailed but reasonably elementary references are available.[1, 2] A passing acquaintance with geometry and trig opens further horizons in classical antenna theory and practice.[3, 4] Even if you refuse to run down to the local ham emporium for fresh reading matter, there is hope. This article is an attempt to suggest the reasonable approach to thinking for yourself in distinguishing antenna fact from antenna fiction.

What do we look for in articles or ads featuring antennas? The list probably goes something like this:

1. Price (Alternatively, cost and effort to build)
2. Gain
3. SWR (standing wave ratio)
4. Front-to-back ratio (also front-to-side ratio)
5. Bandwidth
6. Size and weight

The order of priority varies with the individual, but all of these items are significant. Some of

us (apparently) are also swayed by recitations of DX worked with the new antenna, usually in a short period of time with 150 watts or less.

Price

The *price* factor is pretty much beyond the scope of this article, except to note that the price you pay is generally reflected fairly well in the physical construction of the antenna. If physical strength is not too much of a factor in your location, price is not a very good indication of the "best" array for you.

Gain

Gain, generally speaking, is the ratio of power density radiated by the antenna in its most favored direction to power density radiated by a specified reference antenna in its most favored direction. Two types of reference antennas are in common use—the half-wave dipole and the more esoteric *isotropic* radiator. The latter is a hypothetical device which radiates uniformly in *all* directions, three-dimensionally. Because of the dipole's mildly directive pattern, it exhibits a little over 2 db gain, referred to the isotropic radiator. Antenna gain figures have significance *only when the reference antenna type is explicitly stated.*

Practical high frequency antennas for amateur use must ordinarily operate within a very few wavelengths (at most) of ground. This nearby reflective surface drastically influences every antenna's vertical radiation pattern. Consequently, the most favored direction must be described not only as forward, but also in terms of the vertical angle of the main lobe. The influence of nearby ground on antenna gain, vertical pattern, and feed-point impedance is discussed at length in the references. It is sufficient here to point out that one antenna may in practice show *apparent gain* over another simply because the elevation of its main lobe happens to correspond more closely to the optimum vertical radiation angle for the particular path and propagation conditions existing at the time.

A confusion factor introduced by current receiver design practice is the *S-Meter Decibel*, or *SMDB*. Over the years since Hertz and Marconi, it has become popular to express power ratios by finding their common logarithm (yielding the ratio expressed in *bels*) and multiplying by 10 to get *decibels*. Recently, receiver designers have found it unnecessarily restrictive to calibrate S-meters in terms of conventional S-units of 6 old-fashioned decibels (db). The exact definition of the new S-unit is something of an enigma. Consequently, only data taken with laboratory test equipment, or with a receiver calibrated by laboratory methods, can be relied on to indicate the true pattern of an antenna. This is one of the biggest reasons why authors' claims for homebrew antennas must usually be taken with a large grain of salt.

Standing Wave Ratio

The subject of standing wave ratio (SWR) has been widely treated in ham literature, yet many gross misunderstandings persist. Simply stated, SWR is the ratio of impedance mismatch between antenna and feedline. Since the feed-point impedance of any antenna varies considerably with height above ground and distance from surrounding objects, near-unity (1:1) SWR can ordinarily be achieved only by the use of an adjustable matching device. It is unrealistic to *expect* better than about 1.5:1 SWR from any antenna, beam or otherwise, unless it is at least a wavelength clear of all objects or is matched while in position. As others have pointed out, though, an SWR of 1.5:1 is of little consequence insofar as line losses are concerned.[a] At 28 mc 100 feet of fresh RG-8/U coax will introduce about 1 db loss when perfectly matched to the load (1:1 SWR). The existence of a 1.5:1 SWR causes only about 0.02 db additional loss. As a matter of fact, an SWR of about 13:1 is required to double the 1 db loss inherent in a perfectly-matched line! On the other hand, high SWR presents difficulties with respect to transmitter loading and the use of a low-pass filter. Also, a system operating with high SWR on the transmission line is usually more frequency-sensitive than a well-matched one. The most important thing to remember is that trimming the feeder or using an antenna tuner at the transmitter changes only the *apparent* SWR (actually, the live input impedance) seen by the transmitter. The *actual* SWR on the line, and hence line losses and system frequency-sensitivity, can be changed *only* by varying the match at the antenna.

Estimating the Probable Performance of Arrays

Although it is sometimes difficult to accurately evaluate the validity of performance claims, a respectable estimate can often be achieved by combining some knowledge of basic radiating elements with a bit of insight into the effect of array configuration. A most useful principle to remember is that of *pattern multiplication*, which may be stated thus: the overall pattern of an array of elements is determined by multiplying (the pattern of a

[a] See Ref. (1), pp. 77, 84, 85.

single element of the basic type used) X (the pattern of a similarly spaced and phased array using isotropic radiating elements). Also, the principle of reciprocity states in effect that the transmitting and receiving patterns of an antenna are identical. If a voltage applied to antenna A produces a current in antenna B, then the same voltage applied to B will produce the same current in A. This principle of reciprocity applies *only* if the medium connecting the two antennas is linear and bilateral—that is, if propagation characteristics of the connecting path are identical in either direction. This is often not the case with ionospheric skip.

Aside from the composite array's radiation pattern in the horizontal plane, its SWR, and its bandwidth, some thought must be given to the implications of polarization and propagation phenomena, the antenna environment (height and surrounding objects), and so forth. Finally, one should recognize that "DX worked" recitations are significant only when the antenna in question is compared directly, on a contact-by-contact basis, with a reference antenna whose characteristics are well-known. Even the most casual ham should realize that band conditions vary greatly with time, that spectacular results frequently can be achieved with low power and simple antennas, and that SMDB's cannot be relied upon. Even contest results have little significance without details as to operator and equipment, quantity, quality and dedication of the competition, and propagation conditions.

The majority of antenna interest and advertising in amateur publications today is related to three varieties of *parasitic* array—the conventional parasitic beam or yagi, the cubical quad, and the "dual diversity" array recently described in *73*.[6] A wide variety of *driven* arrays (i.e., those whose elements are all excited directly by physical connection to a feed system) are described in the references, and are capable of giving good results without undue complexity. None of these has approached the popularity of the rotable parasitic array for amateur usage however, probably because the latter offers somewhat better (unidirectional) gain per square foot of sky. Two simple driven arrays are nevertheless of substantial current interest, due to their use as elements of the parasitic arrays mentioned above.

The one-wavelength square loop, used as the basic element of the cubical quad, is shown in Fig. 1a. It is convenient to think of this as two half-wave dipoles, spaced vertically by

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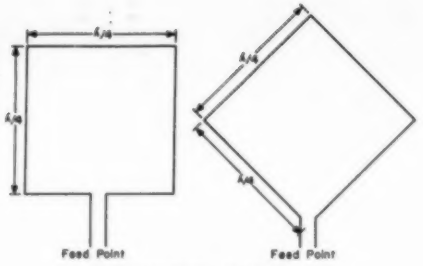
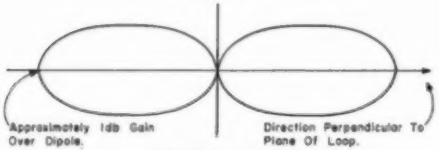


ONE-WAVELENGTH SQUARE LOOP

FIGURE 1A



HORIZONTAL PATTERN
One Wavelength Square Loop

FIGURE 1B

one quarter wavelength, with corresponding (eighth-wave) end sections bent 90° to meet. Since the two dipoles are "in parallel," they are electrically in phase. The gain of a broadside 2-element array of half-wave elements spaced a quarter-wave is of the order of 1 to 2 db over a dipole. The end eighth-wave sections normally contribute little to radiation because of the small current which flows in them; hence, the loss due to bending these ends 90° is small—not over 1 db. Thus the net gain of the full wave loop is slightly under 1 db, with directivity perpendicular to the plane of the loop (broadside). (See Fig. 1b.)

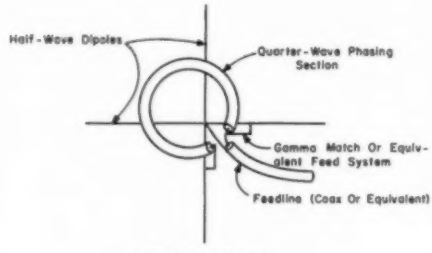
The *turnstile* antenna, shown in Fig. 2a, is commonly used at VHF and UHF, with the dipoles in the horizontal plane, as an omnidirectional radiator with horizontal polarization and a gain in the horizontal plane of about –3 db. Along an axis perpendicular to the plane of the dipoles, however, the turnstile radiates with circular polarization and a gain of approximately 2 db over a reference dipole (Fig. 2b). This antenna is the basic element of the K6CT "dual diversity" array.

The third type of basic element widely used in parasitic arrays is the dipole itself, with a gain (by definition) of 0 idle db (one). The horizontal pattern of a horizontal dipole is a figure eight, as shown in Fig. 3a; that of a vertical dipole is circular, as in Fig. 3b.

Now we need some information about the pattern (and gain) of the basic parasitic configuration and we will be ready to analyze our three popular beams. Table I derived from calculations and measurements made in numerous professional labs, using conventional yagi arrays. Applying the pattern multiplication principle "backward," we divide the yagi pattern(s) by that of a basic dipole element in order to derive the pattern characteristics of an equivalent array of isotropic elements.

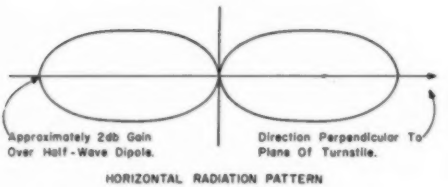
It should be noted that gain is more a function of total boom length than of number of elements; placing more elements than indicated by the table on a boom of the length specified results in only slightly increased gain (seldom much over 1 db). The operating bandwidth over which pattern and SWR remain fairly satisfactory is substantially reduced, however. The range of maximum gain values given in the table results from differences of opinion among various experts, and illustrates the considerable difficulty of making precise gain determinations.

The gain of a dipole (with respect to a dipole) is by definition 0 db. Pattern multiplication for parasitic arrays of dipole elements



TURNSTILE RADIATOR

FIGURE 2A



HORIZONTAL RADIATION PATTERN
Turnstile In Vertical Plane

FIGURE 2B

TABLE I

Maximum possible gains of parasitic arrays of isotropic elements (referred to a single isotropic radiator)

No. Elements	Boom Length, Wavelengths	Max. Gain Range, db
2	0.1	5.0-5.7
3	0.3	7.0-8.7
4	0.5	8.7-9.5

More than 4: Add 0.4 wavelength boom length per element; Add 2.5 to 3 db gain for each doubling of number of parasitic elements, up to a maximum of about 20 elements.

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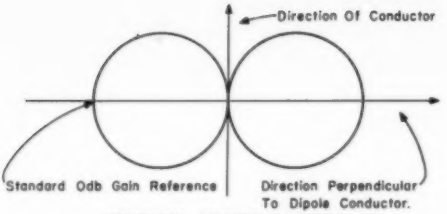
therefore yields exactly the same numbers presented in Table I, except that the gains are now referred to a dipole. The corresponding yagi gains relative to an *isotropic reference* are those given *plus* the 2.1 db gain of the dipole basic element over isotropic. Multiplying the *basic* array pattern shape of Fig. 4 by the familiar figure-eight of the dipole elements yields the well-known horizontal pattern of the conventional (horizontal) multielement parasitic beam (Fig. 5).

Applying the same approach to the cubical quad suggests a gain of about 5½ to 7 db maximum (5.0 to 5.7 db array gain plus about 1 db gain for the basic loop. The horizontal pattern of a horizontally-polarized quad is similar to that of the two element yagi; although the null off the quad element "ends" may not be quite as sharp because of the bent elements, the net current in each vertical member is zero and little vertically-polarized radiation occurs. It should be noted that the stacked-dipoles effect of the basic loop results in a slightly greater emphasis on low angle radiation from the quad when relatively close to ground (compared with a yagi at the same height). Experimentally measured quad gain figures have been slightly less than indicated by this analysis; the interested reader would benefit by reading the detailed discussion found in Ref. (5).

The K6CT "Dual Diversity" Array

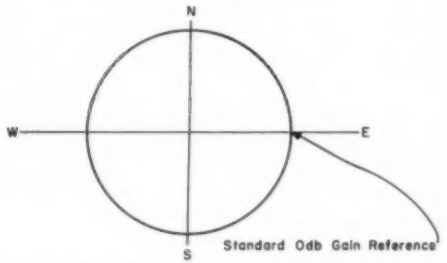
The "dual diversity" antenna described in 73[6] is one for which results of precise, comparative performance tests are not yet available. For that reason it makes an interesting example for the application of our elementary analysis technique. We must realize that this simple approach cannot be expected to provide *precise* numerical answers, and that in some cases it may overlook factors significant enough to change the results appreciably. Thus, our estimate must always be subject to refinement on the basis of more exact analysis or the results of carefully controlled tests. So far, such data has not been published on the K6CT array.

Applying pattern multiplication to a three element parasitic array of turnstile elements yields a probable net gain of about 10 db (2 db turnstile gain plus 8 db array gain) over a dipole. This gain cannot be realized, though, unless the propagation medium permits the transmitted wave to arrive properly polarized at the receiving antenna. For a line-of-sight path, this means that the receiving antenna must also be circularly polarized, with the same



HORIZONTAL RADIATION PATTERN
Horizontal Half-Wave Dipole

FIGURE 3A



(Direction Of Dipole Conductor Is Perpendicular To Plane Of Paper)

HORIZONTAL RADIATION PATTERN
Vertical Half-Wave Dipole

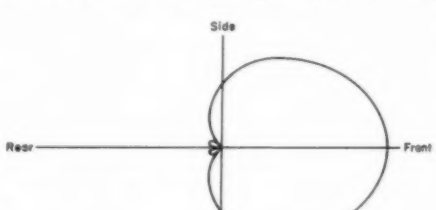
FIGURE 3B

rotational sense as the transmitting antenna. Polarization shift phenomena in ionospheric skip propagation, however, makes this case more difficult to analyze.

As a start, let's consider the K6CT array for what it physically is—a vertical yagi and a horizontal yagi, sharing a common boom and fed 90° out of phase. It can be proven that two yagis mounted in this fashion will not interact (except through the feedline), since each lies entirely within the other's plane of zero potential. (This suggests a practical means for interlacing beams for two bands without interaction worries, but that is another story for another day.) With this background, we can justify treating the array as two separate antennas, each receiving and radiating half of the transmitted power. If the array gain is 10 db, each yagi alone will yield half that, or 7 db.

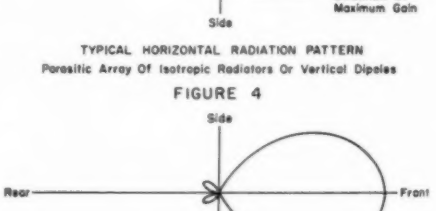
Because of differences in vertical radiation patterns, a signal radiated by a vertical antenna and a signal radiated by a horizontal antenna in the same location generally will not follow the same path to the receiving antenna. In addition, polarization of a wave is often shifted to some degree during the process of ionospheric reflection. Consequently, it is most improbable that the two components of a signal from a K6CT array will retain both their polarization and their phase relationships. Since both characteristics are modified in transit by essentially random effects in the ionosphere, the two waves will generally arrive at the receiver with a random relationship in polarization, phase, and amplitude. In this case, they are just as likely to cancel as to reinforce each other. A complete analysis would require a statistical approach and considerably more propagation data than is readily available; it is probably safe to conclude that, on the average, the effective gain of a "dual diversity" array as described by K6CT will approximate 7 db. The polarization diversity effect may result in greater *apparent* gain, when compared with a single yagi, over a long path at any particular moment.

Neither K6CT's article nor our analysis here attaches any particular significance to the role of the turnstile feed system in providing an antenna with dual polarization. K6CT used it primarily as a convenient method of feeding his two yagis. George stated that the key to "polarization diversity" performance is the antenna's ability to radiate and to intercept both vertical and horizontal polarization equally well. If that is actually the case, then the function can be accomplished by mounting a single yagi with the elements tilted 45°. Something for nothing? Not quite—we lose the 2 db turnstile gain this way. But the configuration of the K6CT array makes it difficult for many hams to support and rotate it. It may often be easier to pick up the extra 2 db gain by lengthening



TYPICAL HORIZONTAL RADIATION PATTERN
Parasitic Array Of Isotropic Radiators Or Vertical Dipoles

FIGURE 4



TYPICAL HORIZONTAL RADIATION PATTERN
Conventional Yagi Array Of Horizontal Dipoles

FIGURE 5

the boom 0.2 wavelengths and adding a fourth element. This approach has been successfully used by the CB boys (you should pardon me for bringing it up here) and it just may be that one isolated occasion where we can learn something from them.

The extent to which the vertical radiation component of a polarization diversity array is doing the work will largely determine the F/B and F/S ratios of that antenna. The horizontal directivity patterns of typical vertical and horizontal yagis are shown in Figs. 4 and 5, respectively. (The vertical dipole's horizontal pattern is circular, like that of an isotropic radiator. Hence the pattern of a vertical yagi is similar to that of an array of isotropic elements.) If the vertical portion is contributing little compared with the horizontal portion, then the apparent array pattern will approximate that of a horizontal yagi. F/B is typically 15 to 25 db and F/S may be 25 to 35 db or higher. If the vertical yagi is contributing significantly to the signal path, however (which it must sometimes in order to justify polarization diversity), then the pattern will look more like that of Fig. 4. Consequently, a good share of the time, the diversity array must be expected to show a F/S as low as only 2 or 3 db. F/B should ordinarily run about the same as that of either antenna alone—certainly there is no reason to expect it to be better. The author has run preliminary tests on a pair of "dual diversity" arrays of the K6CT variety, and the results, though not precise, do tend to confirm the preceding estimates.

Conclusion

This article has underscored several of the more significant factors which must enter into the evaluation of an antenna's actual or potential performance. Application of the principles and facts presented here should enable most hams to arrive at fairly sound conclusions relative to advertising claims and the selection of that new beam. Better yet, it may even influence a few rugged individuals to page through an antenna manual or two, rummage through the neighborhood surplus yard, and then *build* themselves some exotic scenery. Antennas are one of the comparatively few remaining areas in ham radio wherein the home handyman can meet or beat store-bought gear with modest effort, save money (even considering trade-in!), and derive a sense of satisfaction.

. . . K6CTV

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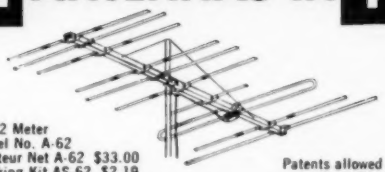

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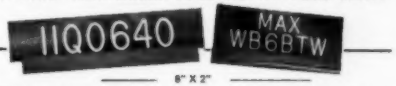

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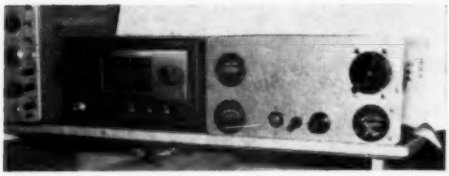


How to Fill a Box

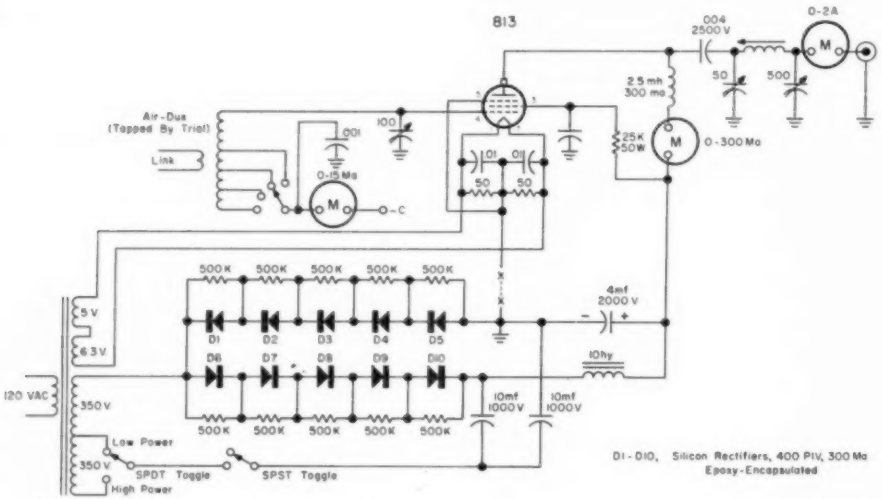
Robert Baird W7CSD
3740 Summers Lane
Klamath Falls, Oregon

When you see a Jim Dandy metal cabinet with chassis and front panel at a bargain price, do you ever get a yen to see just how much stuff you can crowd into it? I suspect that this is one of the secret vices of that group of hams who get their kicks out of construction projects. It's something like not being able to walk past a surplus radio store.

Well anyway, when I saw WRL pricing a cabinet, complete with all of the above, for $2.98, the temptation was too much; in fact, I purchased two. I decided to build an 813 final amplifier, complete with power supply, all in this 15" x 7" x 9" box. The results may be viewed in the illustration.

Construction

When you anticipate mounting this much hardware on a chassis you spend a whole day just figuring out where to punch the holes, what size holes to punch, finding the necessary punches and drills to do the job and, last but not least, punching said holes. It helps to either own the necessary punches or have a friend who will loan them. Various holes were punched or drilled to satisfy the needs of transformers, meters, dials, chokes, filter condensers. etc. The roller coil, resurrected from an old BC-375E, was mounted on bushings behind the panel and the 813 was mounted horizontally with the plane of the filament in a vertical position. Under the chassis a tapped grid circuit was placed next to the front panel. The resonating and loading capacitors of the plate circuit are to the rear. Actually, plate tuning is achieved by turning the roller coil from the front, though the resonating capacitors may be turned by reaching behind. It is a double



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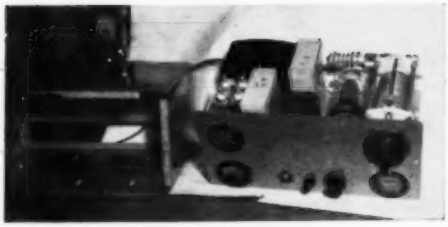


spaced midget dug up from the junk box which, when clear meshed, just tunes the tank circuit on 80 meters. The loading capacitor is a 500 mmfd single spaced job and of course needs adjustment once per band. The rest of the component placing should be self evident from the photograph, with the exception of the silicon rectifiers which are mounted under the chassis with 500K resistors shunted across them on a fiber terminal strip.

The circuit of the amplifier is a straight forward arrangement with band switching in the grid circuit by means of a tapped coil. The combination roller coil and tank capacitor in the pi-network of the output will reach all bands. Neutralization has been left out for want of space for a neutralizing capacitor. The amplifier is stable on 80, 40, and 20 without neutralization. If much were to be done on 15 or 10 some method of neutralizing should be incorporated. Possibly a reversed link could be used.

The power supply utilizes a 700 v transformer resurrected from antiquity, but any TV replacement transformer will work. The rectifiers are 400 PIV 300 ma 25 cents a piece items available from almost any bargain sheet. These are bridged with 500K ½w resistors to insure equal voltage division or inverse peaks. The low-high power switch makes it possible to operate at half or full voltage. The 5 and 6 volt filament windings are connected in series to furnish 10 volts for the 813. With the power switch off the voltage is a little high but is about right when the power supply is turned on and loaded.

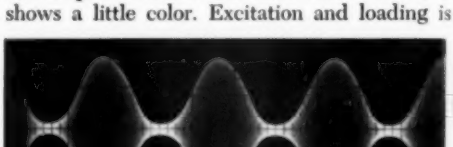
Operation

The photo shows the 813 amplifier being driven by an HT 18. This furnishes about 4 watts of drive which is sufficient drive for anything but plate modulation. Fireworks would result if you tried to plate modulate an amplifier of this size with the spacing provided in the box anyway. Using the NFM exciter pictured I get about 125 to 150 watts output with an input between 200 and 250 watts. Gridleak bias is satisfactory for this mode of operation. If CW operation is to be used, part of the bias should be battery, causing the plate current to drop just sufficiently to be within the dissipation rating of the tube, but not low enough to unload the power supply. If the power supply were switched to the low voltage position it would be alright to operate with class C battery bias on CW.

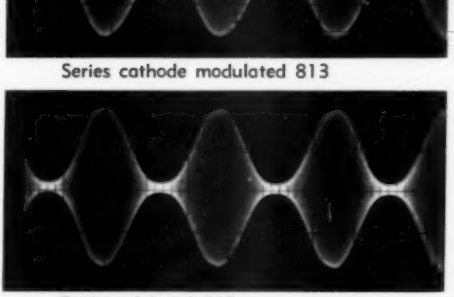
Several varities of AM were tried. Perhaps the best and cheapest was the use of a series 6AS7G cathode modulator. With this circuit the effective voltage of 813 is down to about 1200 volts or less and plate current will run around 125 ma when properly loaded. With this arangement about 60 watts of well modulated *if* output is obtained, as can be seen in the accompanying photo taken with a polaroid attachment for a Tektronix scope.

As with all methods of variable efficiency modulation the loading must be heavy and the excitation must be reduced to a lower value than when operating CW.

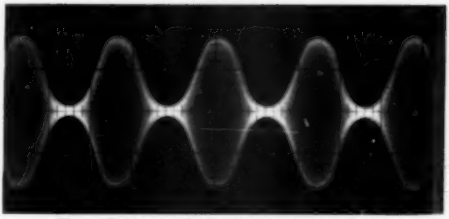
Standard grid modulation using battery bias and transformer coupling works very well also. In this case the voltage goes to about 1600 volts with a plate current of 115 ma. The efficiency is lower but the added input brings the output to about the same value. The 813 shows a little color. Excitation and loading is



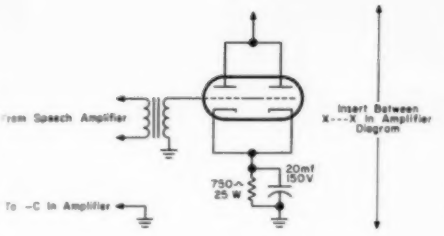
Series cathode modulated 813



Grid modulated 813



Class B linear 813, driven by 6K6 plate and screen modulated



SERIES CATHODE MODULATOR

a bit more critical than with the cathode modulation but, as can be seen from the photo, the pattern is about the same.

Using fixed bias in the neighborhood of 175 volts (this seems high but seemed to be the value for our particular 813 of unknown history) the amplifier works very well as a class B linear AM amplifier. Not having AM in the exciter pictured we used parts of an RCA demonstrator which had a single 6K6 plate and screen modulated. The plate voltage and current value of the 813 stage were about the same as with grid modulation. As can be seen from the pattern, there is slightly more tendency toward flattening.

If the resting current were held to about 75 ma (to avoid too much voltage variation) the amplifier should work ok as a SSB linear. This was not tried.

All in all we got quite a bit in a very small box and it will serve very well for our portable needs which call for a little power.

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Four Bands on the KWM-1

Louis Weber K6GHU
762 Juanita Avenue
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With the declining sun spot cycle and loss of availability of the higher frequencies, the usefulness of the KWM-1 is limited by the lack of 40 & 80 meters. I decided I would try to put mine on 40 meters with the idea that the original 3 bands would not be affected in any way and no holes would be put in the front panel or cabinet. I succeeded to the extent that it can still be operated exactly according to the instruction manual with no apparent changes and yet, with a few simple adjustments, it operates on 40 with equal facility.

The first change, and one you may want to make even though you go no farther, is to make the unit operate on either upper or lower sideband. This is comparatively simple and anyone should be able to do it. The only parts that are needed are a plated crystal and socket, and a spdt slide switch. The crystal * should be calibrated to .01% or better as measured into a 32 mmfd input capacity. To find the proper crystal frequency take the BFO crystal frequency and subtract 455 kc from it. Then taking this number subtract it from 455 kc and you get the lower sideband BFO crystal frequency. For instance, my crystal was 456.95 kc, subtracting 455 kc I got 1.95 kc. Then subtracting 1.95 kc from 455 kc I got 453.05 kc.

Before installing any parts drill a 1/32 inch hole through the slide button of the switch. Install the crystal socket to the right and slightly forward of the present crystal socket XY1 on the chassis and tie the two adjacent terminals on the crystal sockets to pin 1 of V9. Mount the spdt slide switch on a small aluminum bracket directly below the crystal sockets and tie the center of the slide switch to pin 6 of V9. Tie the outer terminals of the crystal sockets to the outer terminals of the slide switch. Put a 6 inch piece of 1/32 inch piano wire through the hole in the switch button and place a right angle bend in the wire above and below the button and run the other end out through one of the holes in the case (see Fig. 1); bend an end on it and trim to a convenient size so that you can throw the switch. This will allow you to operate on either upper or lower sideband. Although the Collins KWM-1 book says this crystal should match the mechanical filter, I ordered the new crystal, as calculated, and it worked very well; in fact, I have tried 3 different 3.1 kc Collins filters with it and there was no noticeable difference.

To put the KWM-1 on 40 meters it is necessary to extend the range of the four exciter tune coils. Since they are designed to tune from 10 meters to 20 meters by increasing the

* From R. E. Woods Electronics, 2164 North Parkway Drive, El Monte, Calif. for $4.95 plus tax and postage.

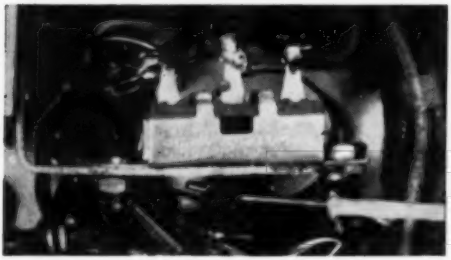

Fig. 1

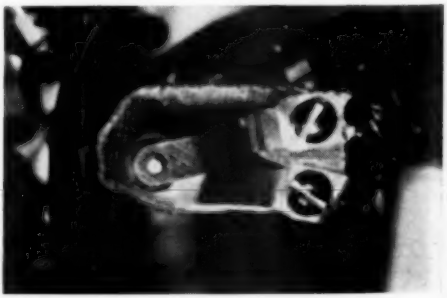

Fig. 2

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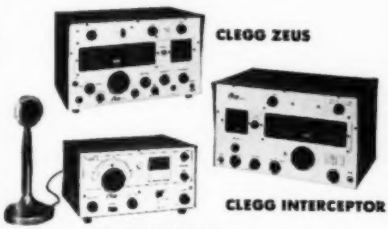

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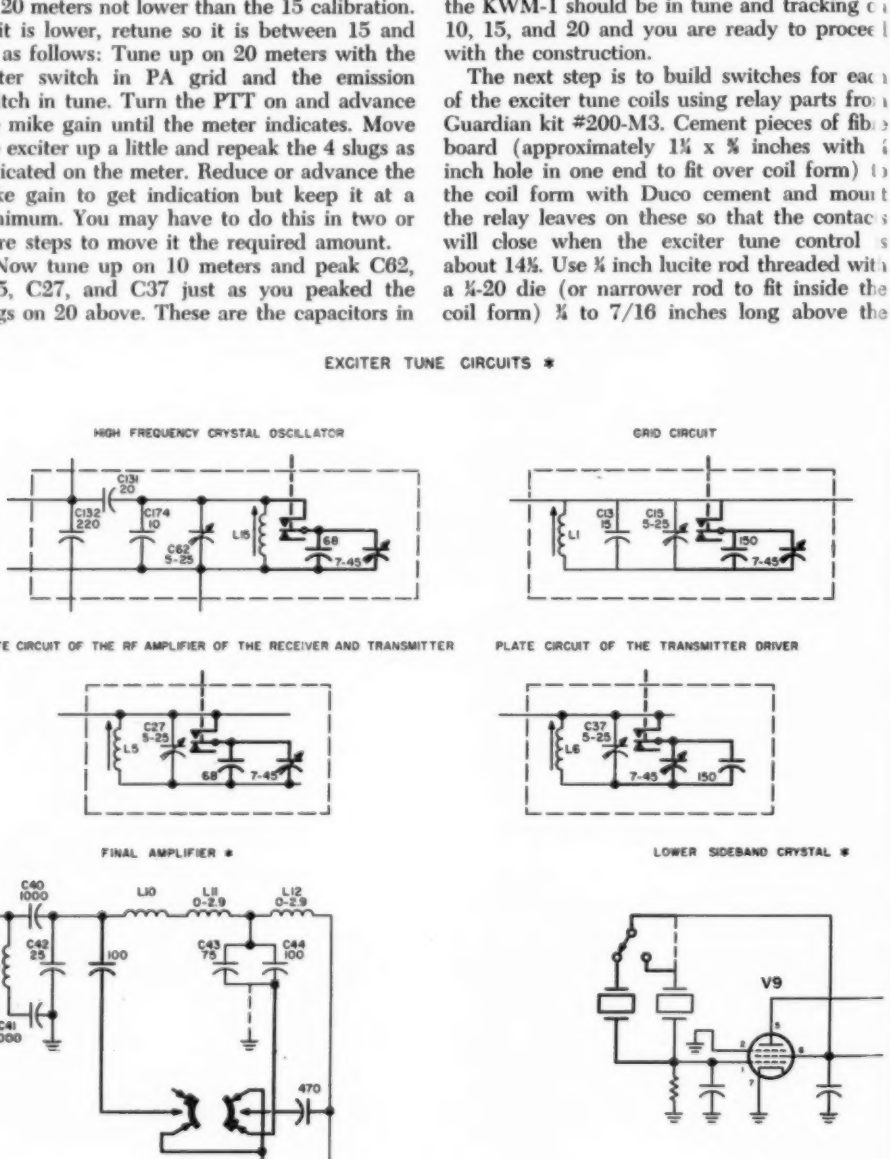
inductance with the slugs, it is possible to add enough capacity to go to 40 meters and still maintain approximately the same LC ratio as it has on 10 meters.

The first step in putting the KWM-1 on 40 meters is to check the exciter tune control. This should peak the lowest frequency you use on 20 meters not lower than the 15 calibration. If it is lower, retune so it is between 15 and 16 as follows: Tune up on 20 meters with the meter switch in PA grid and the emission switch in tune. Turn the PTT on and advance the mike gain until the meter indicates. Move the exciter up a little and repeak the 4 slugs as indicated on the meter. Reduce or advance the mike gain to get indication but keep it at a minimum. You may have to do this in two or more steps to move it the required amount.

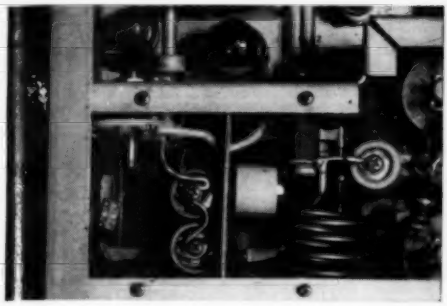
Now tune up on 10 meters and peak C62, C15, C27, and C37 just as you peaked the slugs on 20 above. These are the capacitors in the cans, next to the slugs, accessible from the top of the chassis, right under the exciter tune bar. After you get the capacitors peaked for 10, you go back and repeak the slugs on 20. You repeat this process until no additional improvement is apparent and 20 tunes high enough so that you have room to tune 40 below it. The KWM-1 should be in tune and tracking on 10, 15, and 20 and you are ready to proceed with the construction.

The next step is to build switches for each of the exciter tune coils using relay parts from Guardian kit #200-M3. Cement pieces of fiber board (approximately 1¼ x ¾ inches with ¼ inch hole in one end to fit over coil form) to the coil form with Duco cement and mount the relay leaves on these so that the contacts will close when the exciter tune control is about 14½. Use ¼ inch lucite rod threaded with a ¼-20 die (or narrower rod to fit inside the coil form) ¼ to 7/16 inches long above the

EXCITER TUNE CIRCUITS *



Changes and additions are indicated by heavy lines.



slugs to actuate the relay leaves and thus close the switches. Adjust the length of the rods and the position of the relay leaves so that all four switches close at about the same position—about 14½ so that they open soon enough to peak 20. See Fig. 2 for more details.

Mount a 7 to 45 mmfd trimmer (Centralab 822BN, 825BN, or Erie TS-E) in the top of each can that goes over the coils so that it can be tuned with the can in position. Be sure the trimmer does not interfere with the switch action or short the switch to ground. Use about a #28 insulated flexible wire to connect these trimmers in parallel with the disc ceramics to be added. (See Fig. 2)

On each coil solder in a disc ceramic of the proper value and wire in the trimmer so that when the switch is closed they are in parallel with the original capacitor in the tuned circuit. Add a 68 mmfd capacitor and the trimmer in parallel with C62 and C174. Add a 150 mmfd capacitor and trimmer in parallel with C13 and C15. Similarly a 82 mmfd capacitor on C27 and a 150 mmfd capacitor on C37.

Get a crystal for 40 meters and plug it in any socket of the crystal box which you can spare. The frequency of this crystal is simply the bottom frequency of the band you want plus 4 mc and divided by 2. For instance, if you want 7200 kc for 40 phone, then by simple math $(7200 + 4000) \div 2 = 11200$ kc $\div 2 =$ 5600 kc (.01% xtal into 32 mmfd input). If you have followed all steps so far, you should hear 40 meters when you use the crystal and peak the exciter tune between 14 and 15, although nothing has been tuned up yet.

The next step is to convert the final to tune 40 meters. Install a rotary ceramic switch with at least 2 poles in the front wall of the high voltage compartment. Connect one end of a 100 mmfd mica condenser to the hot end of C42 and the other end to the ceramic switch. Lift C43 and C44 from ground and connect the ground end to the switch by taking them off the divider wall and mounting them on a #14 to #18 wire connected from the juncture of L11 & L12 to the switch. Let the ceramic parts of C43 and C44 rest against the wall for support. Finally connect a 470 mmfd silver mica capacitor from the output end of L12 to the switch. See schematic for switch connections. By drilling an 1/32 inch hole in the switch knob and using a piece of bent piano wire out through the side cabinet holes, you can actuate the switch without opening the cabinet (see Fig. 3). If you desire, you can align the switch with the anti-vox control and use a shaft through this hole to control the final switch. If this is done, put the anti-vox pot on a dual coaxial pot with the vox gain and you still haven't drilled a hole in the cabinet.

This completes the conversion and all that remains to be done is the tuning. Set the exciter tune control about half way between the stop and where the switches open. Get a strong signal on 40 meters from a signal generator or the calibrate position of another transmitter and peak the trimmers on the front three exciter cans. (Note: cans must be in position over coils). Now, with the meter in grid position, quickly set the fourth trimmer approximately in tune the same way you did for tuning in the beginning. Next set the PA tune to 0 and dip the final with the PA load control. Finally, peak the four trimmers with the meter in grid as described before and the job is done.

The final has been changed from a pi L to a pi network on 40 meters only so the two coils are in series and it is only necessary to tune the load control on 40 meters.

Your KWM-1 will work exactly as it always has, but when you switch to the 40 meter crystal and peak the exciter tune between 14 and 15, you will hear 40 meters on the receiver just like you hear 10, 15, & 20. Throw the switch you have installed on the final and tune up by tuning for a dip with the load control (the final tune is at zero) and you are ready to operate on 40 meters. . . . K6GHU

BIBLIOGRAPHY

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75 Meters with a KWM-1, John Englested W1VLN, QST, May 1959, page 22.

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65 foot 80 Meter Dipole

Joe Goode W6LVT
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Santa Ana, Calif.

With the rash of new SSB multi-band transceivers hitting the market these days, more and more amateurs will be presented with the problem of installing 80 meter antennas. Those of us who live in houses located on small lots have a problem. The following is one solution.

There is nothing new about inserting an inductance in series with an antenna to shorten the mechanical length, or connecting two or more dipoles to one coax feed line. However, finding descriptive information for the construction of such antennas is difficult.

Those amateurs who have a 40 meter dipole antenna but lack space for a full length 75 meter dipole can, for $3.50, put up a 75 meter antenna using the same space, same supports and feed line as the 40 meter antenna. The only expense is the purchase of two loading coils and necessary antenna wire and insulators.

As to the results of this antenna, the following can be said . . . when compared to a 23 foot vertical with a bottom loading coil, there is a radical improvement on 75 meters. During a 30 minute period the other evening, contacts were made in Texas, Georgia, Hawaii and Oregon. Signal strength was 9 or above with the exception of Hawaii.

The construction of the antenna is illustrated in Fig. 2. The loading coils are located 20 feet from the feed line. The high current portion of the antenna takes place in this first 20 feet, allowing the use of number 18 wire in

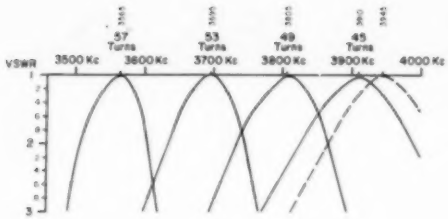

FIGURE 1

FIGURE 2

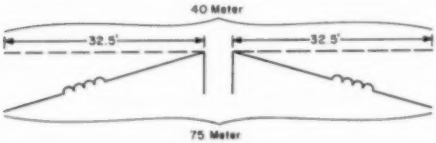

FIGURE 3

the loading coils. 12 feet of wire connects to the other end of the loading coils.

The loading coils are B & W type 3023. Turns are removed to tune the antenna to the desired frequency. Refer to Fig. 1 for correct number of turns.

Plastic strips ½ x 4 inches were cemented to the coil forms. Holes were drilled in either end of the strips. 6-32 screws were used to connect the antenna to the strips and either end of the coils. The plastic strips act as strain insulators as well as supports for the coils. Discarded toothbrushes will yield enough plastic strip for your installation.

Plastic sandwich bags were slipped over the loading coils for protection from snow, ice, rain, dirt and birds. (Southern California installations delete words snow, ice and rain.)

Fig. 3 shows installation of the antenna to an existing 40 meter dipole, using the same coax. Strain insulators are connected to either end of the 75 meter antenna. The ends of the 75 meter antenna are tied to the 40 meter antenna supports. The spacing between the 40 and 75 meter antennas is not critical as long as they do not touch each other.

Fig. 1 charts VSWR characteristics vs frequency. Number of turns pertain to each coil L1 and L2.

Check out procedure for the antenna after installation is as follows. Assuming that the 75 meter phone band has been selected and the loading coils have been adjusted to 45 turns, load the transmitter to the antenna. Change the frequency for minimum VSWR. Let's assume this takes place at 3950 kcs. The dotted curve on Fig. 1 indicates such a condition.

To cover the phone band with a minimum VSWR, it is desirable to have the resonant point at approximately 3900 kcs. To accomplish this it was only necessary to increase the length of one end of the antenna by 3 inches.

During the process of adjusting the antenna, each end of the antenna should be varied by the same amount if the adjustment requires more than 6 inches.

The 12 foot section of the antenna should be cut to 13 feet. The extra foot of length can then be twisted back over the 12 foot section. This will leave approximately one foot of wire that can be used for adjustment without splicing.

The exact length will be dependent on the installation. Surrounding objects will cause the end loading to vary. The added one foot of length should be adequate to compensate for these variations.

A VSWR indicator is desirable to make these adjustments. If one is not available, the transmitter will suffice. Vary the frequency of the transmitter until the maximum antenna load is determined. This will be the point of minimum VSWR.

. . . W6LVT

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5-7-9

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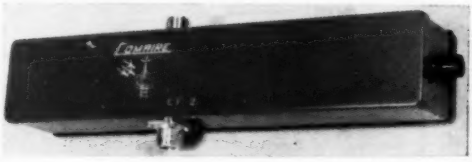

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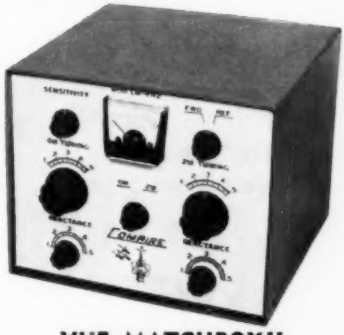

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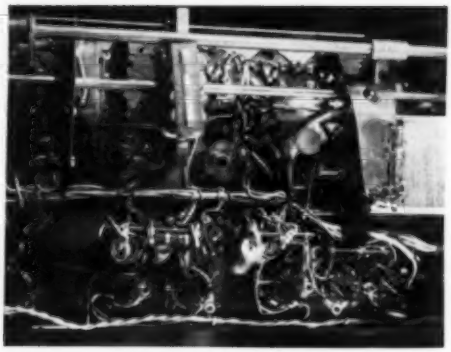

Photo 1.—A top view of the receiver. Note that a bead of solder extends the full length of the sideband selection box.

The Drake 1-A receiver is an excellent ham band receiver that was designed primarily for single sideband reception. CW is also received with ease, but AM reception leaves something to be desired. It is true that AM can be received by the exalted carrier method, but if the AM station is not stable, FM's or if several AM stations in a QSO are not exactly zero beat—which is more the rule than the exception—it soon becomes desirable to have available a detector more suitable for AM.

This is easily accomplished in the Drake 1-A and the price is probably within the reach of every Drake 1-A owner—72¢. The big fear of drilling a hole in the panel or cabinet is unfounded for this modification as the switching from AM to CW-SSB reception has been resolved by doubling up on one of the existing

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panel switches—the antenna trim control. Some of the later model 1-A Drakes have already doubled up on this control and use it to switch in the crystal calibrator. This will not, however, alter the SSB to AM conversion except that the antenna trim control will have a triple function.

The antenna trim shaft is removed from the antenna trim condenser and a quarter inch shaft coupler is slipped onto the fibre rod. The shaft is then reunited with the trim condenser and the quarter inch shaft coupler is moved up the shaft to a location about three inches from the front panel. (The exact position will be determined later.)

A bracket should be made from a heavy copper strip and bent as shown in Figure 1. The "Top Lip" was tinned with solder on the bottom side to expedite easier soldering later. A small double pole double throw slide switch was mounted on the bracket as outlined in Figure 1 and the photo. (It is advisable to wire the switch before mounting the bracket.)

The bracket is bolted to the chassis with an existing lug that is used to tie down one of the IF cans. The other end is soldered to the sideband selection box that contains T4. (See Photo.) Do not solder, however, until the following steps have been completed:

Insert a half-inch long bolt into one of the tapped holes in the shaft coupler. Move the shaft coupler until the half-inch bolt is centered over the slide switch. Tighten the bolt and the shaft coupler's set screw to the antenna trim shaft. Move the copper mounting

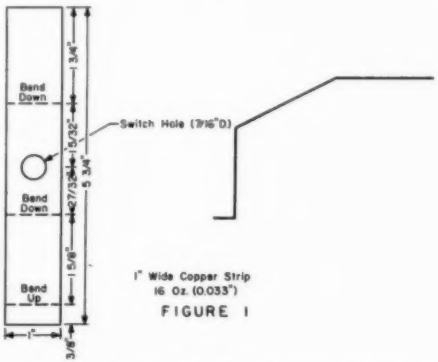

Fig. 1.—A template of the copper bracket constructed to place the DPDT SSB-AM switch near the antenna trim control shaft. Copper was used because of its availability and ease of soldering.

Photo 2.—A side view of the conversion showing the position of the switch, shaft coupler and mounting bracket.

bracket until the bolt in the shaft coupler will slide the switch in both directions by rotating the antenna trim shaft approximately 330 degrees. Solder the copper bracket firmly to the side band selection box. This completes the mechanical portion of the conversion.

The wiring is very simple and straight forward, particularly if the switch was prewired before mounting. The use of shielded wire is recommended, but care should be exercised if the non-insulated type is used to avoid shorting out some portion of the receiver. The .005 coupling condenser used had sufficiently lon leads to reach from the switch to the AGC te minal board, as shown in the photo. Howeve another Drake 1-A (judging from the seri number a much earlier production model tha the one used in the photo) did not have the te minal board and it was necessary to add a extension to the coupling condenser to reac the 6BF6 tube socket. The 270K ohm bi resistor was mounted on the slide switch—th should be done before mounting the bracke

A shielded wire is used in the Drake 1-A t connect the grid of V8 to the cathode of V-1 (see schematic for detail). Disconnect th shielded wire from V-10 and it should be lon enough to reach the new switch. A new lengt of shielded wire is used to connect the swit to the cathode of V-10. This completes th wiring and the conversion, so turn on the re ceiver and check for proper operation befor replacing it in the cabinet.

The AM-SSB switch performs two function when switching from sideband to AM—it re moves the first audio amplifier from the prod uct detector and switches it to the AM detector (combination AM detector and AG rectifier), and it stops the BFO from oscillatin by grounding the feedback.

The new Drake 1-B receiver will perform on sideband and CW as before, except, of course, the new SSB-AM switch should be in the SSB position. AM is received by rotating the antenna trim control until the slide switch is moved to the AM position. The sideband selection control may be placed in either the upper or lower sideband position. The choice can be determined by the QRM and optimum voice quality.

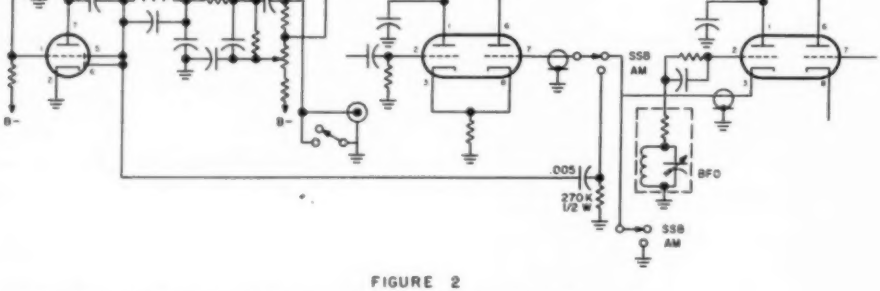

FIGURE 2

Fig. 2.—A schematic of the converted portion of the receiver. Only the new conversion components have values.

I am sure that if you own a Drake 1-A receiver and have the occasion to contact AM stations, you will find this conversion worthwhile, but prepare yourself for a shock. The excellent bandpass qualities that are so noticeable on sideband will also be present in the AM position. It's damn sharp—the stations are either rocking the speaker or absent. However, in the crowded conditions of the present day bands this will work to your advantage. The conversion is simple, inexpensive, can be completed in less than an hour, will not harm the sideband receiving ability, and will increase the versatility of an excellent receiver.

So, if you are thinking of trading your old 1-A for a newer model because it does not have AM receiving facilities, make this conversion and announce with pride, "The receiver here is a Drake 1-B." . . . W5V04

(W2NSD from page 30)

if the amateurs do not live up to the rules in 12.0 that we may lose frequencies. Next they say, "A most significant trend has developed in the last few years which has caused increasing concern to the League as to whether the basic purposes and objectives of the amateur radio service . . . are being and may continue to be adequately achieved."

They then go on to tell the FCC that this "trend" has arisen because they eliminated restricted voice bands back in 1951 and because manufacturers are turning out too much good equipment. The remainder of the petition is taken up with a long list of ARRL Board resolutions and their proposed solution to the "trend," a turning back of the clock to pre-1951.

Frankly I am incredulous that the ARRL Board and its General Council would send such a petition to the FCC. Either they are so caught up in their own arguments that they fail to see the obvious or else they are so sure that they can jam this through by the use of political pressure that they don't feel that they have to stoop to rational justification of their proposals.

The ARRL says there is a trend, they identify its causes and propose solutions. But never once do they in any way identify this trend. And further, they make no attempt whatever to document that their unidentified trend does in actuality exist outside of their imagination. Unless there is some political "fix" in it would seem to me that the ARRL petition should be rejected flatly and immediately by the FCC until the ARRL is able to present a definition of the trend which has caused all this difficulty

(Turn to page 86)

THANK YOU, 73

Model 6100 B&W

Our thanks to 73 Magazine for a job well done in their vivid and accurate review of the new B & W Model 6100 Transmitter in the November issue. (Page 84)

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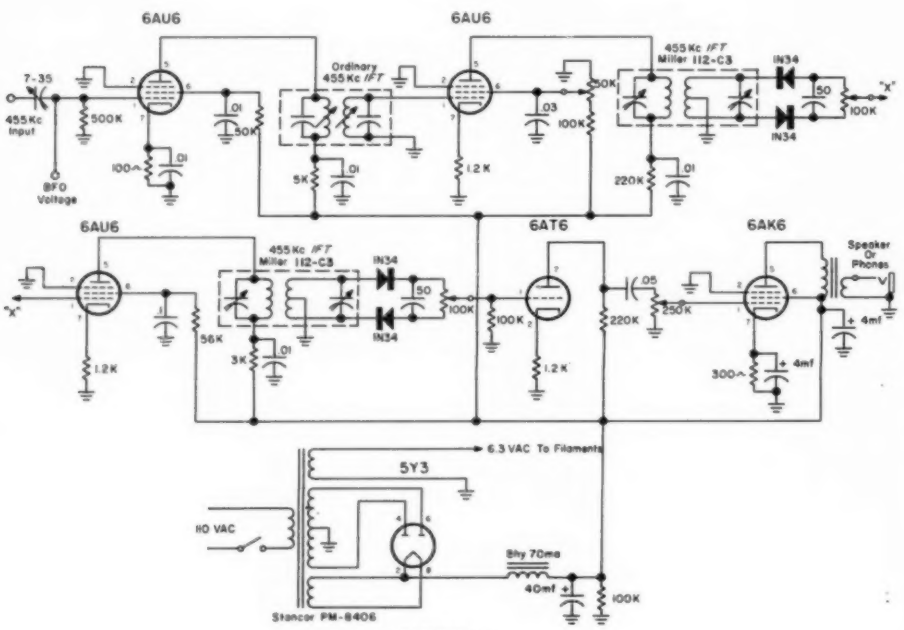

FIGURE 2

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In order for the circuit to do its job well, it has been determined by experiments conducted since the start of the project (May 1957), that two stages of intermediate frequency amplification ahead of the noise reducing circuit are needed for most applications. A complete schematic of the adaptor is shown in Fig. 2. The first amplifier in the string receives its signal through a small series capacitor attached to the plate of a conventional first mixer tube in the station receiver. The first amplifier also receives the beat frequency oscillator voltage. This will be referred to again later in this discussion. The second *if* amplifier has a gain control in its screen voltage supply, and, under strong signals, can be made to work as a limiter stage. Under weak signal conditions, it can also be operated as a normal *if* amplifier. The noise reducer stage receives its signal from the arm of a 100K pot. By adjusting the two 100K potentiometers, voltages are produced which have either negative or positive going values for driving the grid of the first audio amplifier. Moreover, by varying the screen voltage of the limiter stage, changes in amplitude as well as small changes in phase shift can be made in these voltages prior to making them audible for listening purposes. The net effect of the noise reducing system is variable audio bandpass from zero to something over 6 kilocycles wide. The operator is able to select a signal to noise ratio which can improve his ability to read a signal through some discouraging noise conditions. This feature is a valuable enrichment since it has been found that a power line leak can be cancelled

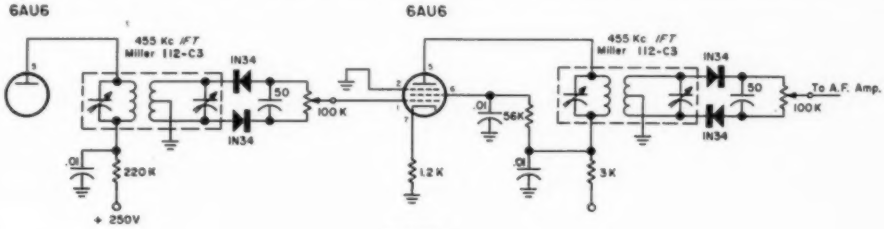


FIGURE 1

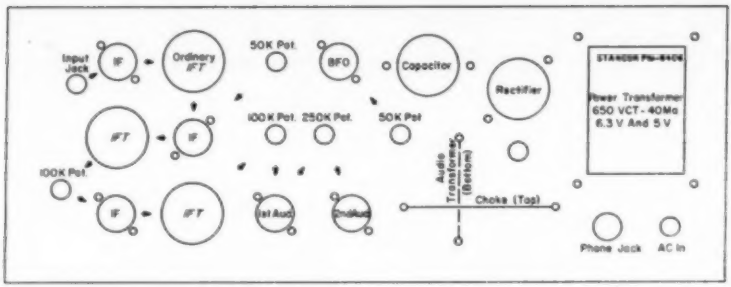


FIGURE 4

out and the code signals brought through for good copy. At the same time, the station receiver, beyond the 1st mixer, was totally blanked out by the buzz.

An important part of the system is the bfo voltage. This voltage needs to be variable from a low value to a value large enough to saturate the first two amplifiers. An adequate range is 0 to 20 or so volts of 455 kcs signal. Fig. 3 shows a suitable circuit. Another is described on page 224 of the 15th edition of The Radio Handbook. When static or noises are severe, crank up the bfo signal until the limiter stage begins to squeeze the crashes or pulses into tolerable listening levels. This will usually take place at some low setting of the 50K pot located in the screen supply of the limiter. The gain of the noise reducer stage is adequate to amplify the weak audio left over from thi squeezing process. All that remains is to jockey the 100K pots until the noise has been balanced out, or, reduced to the point that CW is readable. The system appears to work best on periodic noises such as 60 cycle buzz, ac-dc motors, and Loran pulses; however, it will attenuate atmospheric static and lighting crashes.

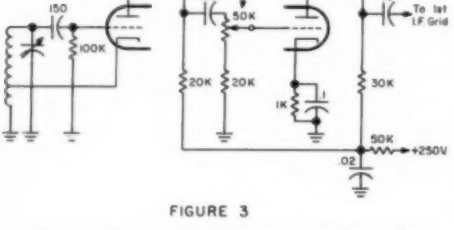
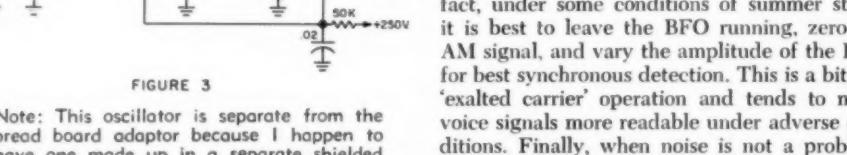


FIGURE 3

Note: This oscillator is separate from the bread board adaptor because I happen to have one made up in a separate shielded box.

The circuit as shown in Fig. 1, requires center tapped secondaries on the *if* transformers. Miller #012-C3 work well with IN34 crystal diodes. It is suggested that the 100K potentiometers be of good quality. Normal construction practices were used on the adaptor and the bread board unit was assembled as shown in Fig. 4. The arrows indicate direction of signal flow or a control associated with a tube or transformer. The components were mounted on a steel chassis plate of 5" x 13" x 1/16" thick. The indicated layout places the potentiometers near their transformers and the shafts are in the clear for ease of adjustment.

A second detector was not incorporated because the CW and SSB sigs are hetrodyned in the first *if* amplifier. When the BFO is turned off, there are enough non-linear elements in the circuit to demodulate ordinary AM signals. In fact, under some conditions of summer static, it is best to leave the BFO running, zero the AM signal, and vary the amplitude of the BFO for best synchronous detection. This is a bit like 'exalted carrier' operation and tends to make voice signals more readable under adverse conditions. Finally, when noise is not a problem, run the potentiometers up toward the end of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their travel and the unit becomes a rather ordinary amplifier strip.

The noise reducer carries no claim of being the ultimate in noise free reception. Variations to be tried in the future include the 'Like New Mixer' circuit described in the February issue of 73. At this station the device is being used on 80 and 160 meters to good advantage. It is the culmination of many pleasant hours of old fashioned experiment, and hopefully may find some use in the radio shacks of the amateur fraternity.

. . .W5SOT

B & W Filters

Six meters is one of the most active ham bands these days, but due to its proximity to channel 2 many fellows have shied away from it, and some have who have built up equipment or invested in commercial gear have been plagued by those rascally indians. It is a shame to have troubles like this when they are so easily cured by the use of a good low pass filter.

Barker and Williamson have just recently come out with two such filters, one for medium power and the other for the high power crowd. The medium power unit, Model 423, will handle up to 100 watts up to 52 mc and reduced power above 52 mc. Its passband is 30-54 mc. The design consists of three sections, an input and output "M" derived section and a middle "K" derived section. It has SO-239 input and output connectors. Price is only $9.66.

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We checked out both filters here at the 73 labs, first running a curve on the passband with our sweep generator. This backed up the published specifications, showing B & W to be on the conservative side. Next we brought out our worst six meter TVI generator and ran it through the filter with our extremely susceptible RCA television set in the next room. Though channel two just barely creeps in here and is normally wiped clean by just about any six meter rig, were able to watch the usual dull trivia all the while the six meter rig was being used.

The B & W filters work, they're reasonably priced, they're small.

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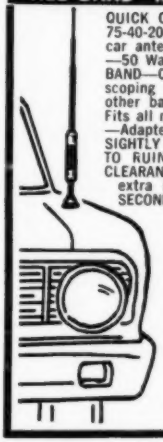

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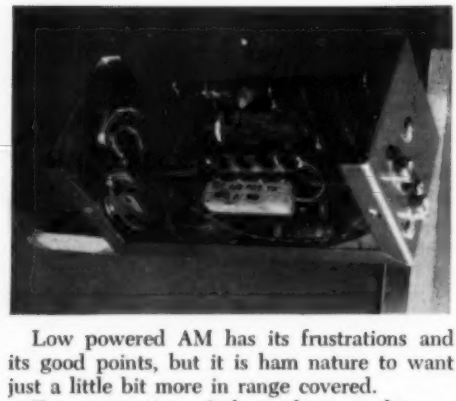

Low powered AM has its frustrations and its good points, but it is ham nature to want just a little bit more in range covered.

For some time I have been seeking a means of improving two low powered commercial transmitters without getting into a major rebuild program.

Negative Cycle Loading appeared to be the answer.

The earliest clear explanation in the ham magazines was January 1959 W2NSD CQ. The article was ritten by Lee Shackle W6PQW who have full credit to that all time great of ham radio, John L. Reinartz K6BJ.

The circuit was also described in QST for October 1956 by W4FHF as the "Ultramodulation System." It was complicated and expensive.

A slightly simpler version by W6MDI appeared in QST for November 1958 as a "Positive Peak Extender."

Another reference to it by W6WYD in May 1962 QST "proves" mathematically that it won't work. Which reminds me of the aeronautical engineer who proved that Bumble Bees can't fly.

For those of you who haven't files that far back, the theory goes like this:

In ordinary AM certain theoretical requirements are necessary for optimum transmission. These are: (1) The Class C final must on the downward half cycle of modulation just reach zero plate current. Carrier must not be cut off

	Instantaneous Values					
Cycle	Plate Current Class C	Plate Voltage Class C	Mod. Output Pwer	Output from final Pwr Supply	RF Pwer Output	Load on Modulator (ohms)
Unmod Carrier	100 ma	500 v	0 wts	50 wts	35 wts	5000*
Positive Peak	200 ma	1000 v	100 wts	100 wts	140 wts	5000
Negative Peak	0 ma	0 v***	0 wts	0 wts	0 wts	Infinity **

Notes: * Subject to argument—my opinion!
** Not quite!
*** Plate Voltage at Class C Final plate is zero due to modulator output voltage being equal, but in opposite phase to the power supply voltage.

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if undesired transients are to be avoided.

(2) The instantaneous peak power on the "up" peak must quadruple the carrier power. That is, the instantaneous plate current and the instantaneous plate voltage must both double on the upward peak of modulation.

(3) For good quality, any change in instantaneous plate voltage must cause a directly proportional change in plate current. This is known as "linearity."

Since we have said that the Class C final is linear, it behaves like a resistor and ohms law applies, hence the Handbook formula

$$R = \frac{E}{I} \text{ or } \frac{\text{Modulating Impedance (Load on Modulating Transformer) Plate Voltage}}{\text{Plate Current}}$$

For example, a single 6146 might have a plate voltage of 500 volts and a plate current of 100 ma. The modulating impedance would then be $\frac{500}{100} \times 1000 = 5000$ ohms.

On the upward instantaneous peak of modulation the plate voltage doubles due to addition of voltage from the modulator, or see table.

From this you can see that the Modulator output must vary from 100 watts to zero watts in approximately 1/500 second.

If the modulator tubes are operating in anything other than Class A, then the upward movement of the output is supplied mostly by one tube. Theoretically, in Class B, one tube supplies the upward and the other the downward.

This means that one tube at the positive peak supplies 100 watts. The other tube at the negative peak supplies zero watts. The Class B tubes are unequally loaded.

The regulation of the Class B stage will not

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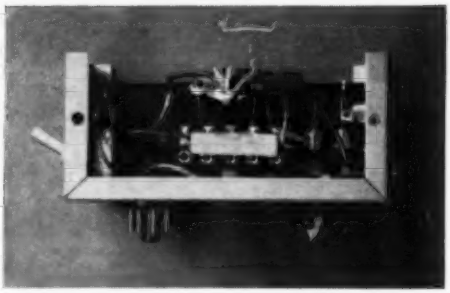

be good. That is the removal of load during part of the cycle will increase the modulator voltage output.

Now let us consider Joe Ham adjusting his transmitter modulation. Using a negative peak indicator, an oscilloscope, or another ham's receiver, he increases the audio input until negative peak overmodulation is just indicated on voice peaks—and he leaves it that. However the negative peaks are distorted, or elongated or accentuated due to the light load on the modulator at this time. The positive peaks are compressed due to the heavy load on the modulator on the upswing. The signal is distorted as in Fig. 1.

Another way of saying this is that the downward percentage of modulation excedes the upward.

FIGURE 1A

FIGURE 1B

FIGURE 1C

FIGURE 1D

FIGURE 1E

FIGURE 1F

Fig. 1A: Sine wave modulating signal.
1B: "Perfect" AM. The Carrier varies from zero to twice normal. The Carrier peaks faithfully reproduce 1A.
1C: Demodulated Carrier reproduces 1A.
1D: Input as in 1A.
1E: 100% downward modulation but upward modulation less than 100%.
1F: Resultant demodulated output shows compression of positive peak.
Note: These are voltage or current wave forms, not power.

Several solutions are possible.

(1) Use negative cycle loading.

(2) Use a smaller tube (or a weak one) for the modulator supplying the down peak.

(3) Use low level half cycle loading to counteract the modulator distortion.

Now back to the "Strange Case of Negative Cycle Loading." If all this was known back in 1959 how come none of the commercial transmitters use it?

Perhaps because as soon as you get control of the negative peaks you find that you need more power from the modulator than can be had in order to get 100% upward modulation. Since Joe Ham is mainly concerned with downward modulation, the smaller commercial transmitters are built to provide more than enough power to downward overmodulate, but upward modulation is somewhat lacking.

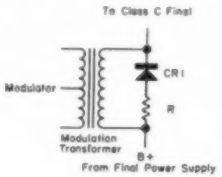

FIGURE 2

Negative Cycle Loading

This is a relatively simple diode and resistor combination (see Fig. 2). On the upward peaks the diode D1 acts as a switch to disconnect resistor R from the modulation transformer secondary. On the downward peaks diode D1 conducts and the load on the transformer secondary cannot decrease below the ohmic value of R.

R is selected experimentally by watching the waveform (wave envelope pattern) on an oscilloscope while talking into the mike. The transmitter af gain control is turned wide open and R is adjusted so that 100% negative modulation just does not occur. This must be done with the final loaded to its normal values.

What occurs in the af section of the transmitter now depends upon the capabilities of the various stages and the circuit position of the gain control. It will probably be found that the audio gain control only increases modulation up to a critical point. Beyond that point overloading occurs and increasing the gain control setting increases distortion but not necessarily power output. In some cases it is possible to increase the B+ to the modulator tubes, which will increase their output, but the actual modulating power is still limited by the capabilities of the modulating transformer. Optimum results occur when the modulation

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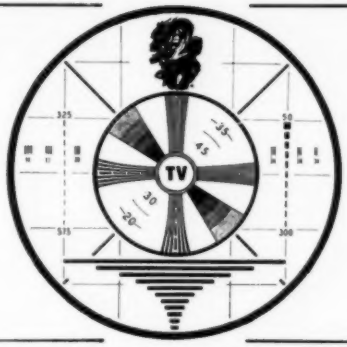

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mplifier is running wide open. Note that this does not necessarily mean gain control at maximum setting.

Since this type of operation results in clipping, very likely in the modulation transformer, some means of suppressing audio harmonics is wise. A condenser of .02 mfd across the modulation transformer secondary is satisfactory. In the Ranger this is already in the transmitter.

Construction

For the Ranger: See Fig. 3 and pictures. The Handibox is 2¼ x 2¼ x 5 inches. Most of the parts mount on a piece of bakelite. The box plugs directly into the external socket on the back of the Ranger—hence the 9 pin plug and jumpers. Phono connectors are used for the external leads to the negative peak indicating meter and for the audio take off for the scope (trapezoidal pattern). To restore the Ranger to normal just replace the original noval plug.

This circuit is more elaborate than necessary since it includes a negative peak overmodulation indicator (to fulfill licensing requirements)

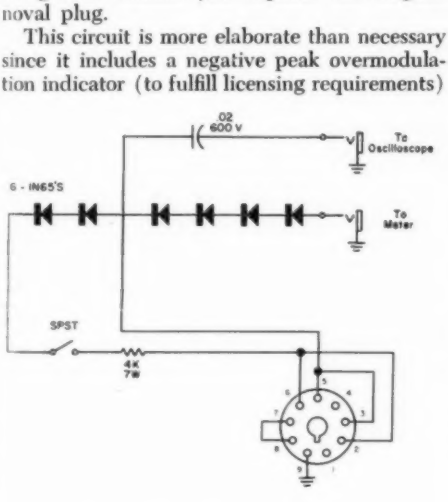

FIGURE 3

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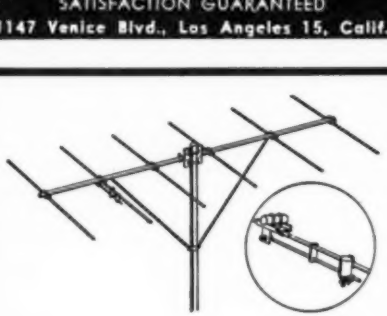

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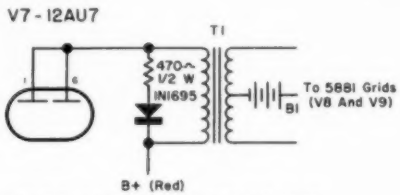
and a switch to cut the limiter out to prove to the RI that the indicator is working. With the limiter on the overmodulation indicator never moves off zero.

To attain the required PIV ratings using 1N1695, two in series were used. This could be simplified to one, and a smaller box used by selecting a diode with a higher PIV.

The meter used in the negative peak over modulation indicator is a one milliamp full scale.



LOW LEVEL LIMITING FOR THE ELMAC AF-67
FIGURE 4

The current shown on the "MOD" position on the Ranger meter switch will be considerably higher than previously. Peaks of 150 ma are not unusual. Bear in mind that any form of clipping frequency shaping or compression is distortion. Do not crowd the mike except under weak signal conditions. But if the lad at the far end is having difficulty, don't be shy.

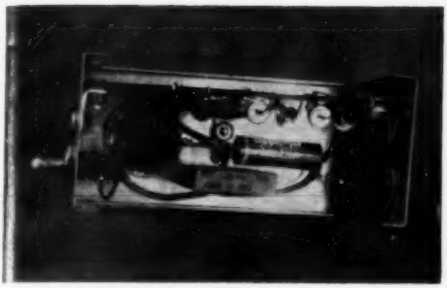
For the Elmac AF67: The same arrangement can be used with the Elmac by addition of the .02 condenser mentioned above. In my case I use a Heath MP1 power supply, and it just couldn't handle the additional power required on voice peaks. So some method of achieving negative peak limiting with less power supply loading was necessary.

The same principle is used, but limiting is applied at a low level point. The Class B modulators are fed a deliberately distorted signal, that is, one whose negative excursions are reduced. The modulator then distorts in the opposite direction. See Fig. 4.

The circuit operates in the same way as the previous one, but is not preferred since it is a compromise which cannot be as accurately established as with the previous method.

The correct connections for the diode should be checked experimentally by use of an overmodulation indicator. If the diode is reversed carrier cutoff will still occur. The resistor value is established by selecting as large a value as possible without permitting carrier cut off under maximum modulation conditions. The two parts can be quite easily mounted under the chassis.

The values arrived at for my Elmac are



shown in Fig. 4, but these may vary in both diode polarity and resistor value depending upon power supply capability transformer T1 and T2 polarities. The circuit shown is a good starting point.

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(Editorial note: 73 will welcome articles on the application of this scheme to other commercial rigs plus any other improvements that may be suggested.)

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An Answer to "Listen . . . Fellow Radio Amateur"

Donald Carnow K9CO
Chicago, Illinois

The object of this paper is to answer the allegations made against the state of our hobby in "Listen, Fellow Radio Amateur" in the November 73. We hope to clear the confusion created by some writers, and to make us stop and examine the problems facing our community.

To the uncritical reader, "Listen . . . Fellow Radio Amateur" is an impressive article. It is written in a clever style, and nicely uses sagicious sounding words. Its purpose is to impress the reader that some people have an insight into problems and others do not. These people attempt to set themselves above the average ham and try to convince us that they know what is best for Amateur Radio. Such an attitude has been expressed by the members of the Board of the Amateur Radio Relay League. However, before we blindly accept such criticism, let's think about our state of affairs.

The article is inconsistent and the author contradicts himself. He states through implication that the article will examine recent criticism with an unprejudiced eye. The reader was initially made to believe that the author would be objective. However, the author goes on and writes as opinionated an article on Incentive Licensing as has yet appeared. He had warned us to be less emotional about the subject and to submit to reason; however, the article was filled with emotional appeals. It uses the techniques of name calling, card stacking, and undocumented testimonals. I contend that such devices need not be used to reveal truth where truth and reason exist.

"Listen . . . Fellow Radio Amateurs" began by citing an ideal definition of Amateur Radio to which we should all theoretically aspire to conform. However, from this very definition, it does not appear that the drafters of the Regulations of the Communications Act wanted to preclude the "communicator" from amateur operations, but the author specifically spoke against the "communicator" as opposed to the technically qualified ham. This F.C.C. definition follows:

> a service of self training, intercommunication, and technical investigation, carried on by amateurs; that is by duly authorized persons interested in radio techniques *solely with a personal aim AND without pecuniary interest.*

Admittedly, reading law is a process of interpretation. However, it is only a supposition that the F.C.C. Regulations had the intentions of preventing the knowledgable communicator from being a ham. If such were the intentions, the F.C.C. license exams would have long ago been made more difficult. The incentive license plan asks for harder examinations. In the light of the above discussion, asking for harder exams only begs the untennable issue of interpretation.

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The first of his errors in logic occurred when the author criticized the current mode of operations by hams when they are on the air or otherwise. I refer to his citing of crowded band conditions, purchase of commercial equipment, and the desire to belong to clubs. All of these were cited as bad practices. However, allow me to justify these conditions. They are all consequences and responses to healthy social conditions. On the first count, every one will admit that ham radio is a popular hobby. Education has progressed to the point where people are better informed today then ever before. With thousands passing the General Class License Exam and wanting to operate, crowded conditions must arise. Secondly, why should one homebrew equipment, when the electronics field has supplied him with kits that save him money?

The desire to belong to clubs should never be considered an absurdity. We as humans are social animals. Everyone of us desires to belong to groups (e.g. families, church groups, clubs, etc.), to see accomplishments of others, and to receive recognition from our peers for our own accomplishments. These are the drives that build well adjusted adults. These are the ends that Amateur Radio provides through similiar interest in communications. We would allow Amateur Radio to exist as an art; but we would not allow it to serve us, if everyone took the attitude of the author of "Listen . . . Fellow Radio Amateur."

Then to add insult to injury the article called the common ham an appliance operator. This is name calling. This type of journalism only clouds the issue and brings about more confusion.

However, the article did not cease ridiculing the amateur operator at this point. After stacking the cards by slanting all the facts to agree with his opinions, the author attacked the ham for some of his idiosyncracies. The author's petty citation of the "break-breaks" and "gimme a clear channel for phone patch" operation, are just a few of the examples.
The critical reader noticed that here the author attacked the operator instead of presenting arguments for his ideas. Very few will deny that it is easier to attack your opponent with insult and emotionally packed words then to logically attack his arguments. In other words, attack the man and not the argument. It is easier and a lot of people are fooled into believing you especially when you have a good vocabulary. Here, again, the argument against or for Incentive Licensing has been confused with someone's emotional drives.

Inconsistencies permeated the entire paper. The following quote from the text should be reviewed:

> "The idea Amateur Radio exists as a hobby is a dangerous one, and a purely amateur concept: to defend . . ."

Do advocates of Incentive Licensing propose that amateurs become non-amateur, or commercial in character?

What motivates the advocates of Incentive Licensing? I do not think it is their altruistic concern for our hobby. In my opinion there are two primary motives:

A. These people are reactionary in character and want to revert back to operating conditions of the early and late 1930's. Such aspirations for uncrowded bands are unrealistic. No one can turn back time. The desire to do so can be interpreted as wanting to satisfy ones ego by bringing back the good old days. In the good old days he was a big wheel and had recognition. Today he is lost in the masses who are also interested in the hobby. He no longer has the recognition that he once had.

B. Superfically, the coming International Conference in Geneva appears as an motive force. However, I consider this a rationalization in the light of the cause stated in A. However, this will be discussed in another paragraph.

Reactionary behavior leads to growth stoppage. The argument of intellectual stimulation not arising from ham radio today is a fallicious one. Intellectual stimulation is relative to the period of time we live in. Considering the many curious items in the field of science, ham radio may not be relatively stimulating today. But it is far advanced on an intellectual basis over 1937.

However, the major indictment of "Listen: Fellow Radio Amateur" has yet to be presented. The author cites several far fetched instances to substantiate his viewpoint. For instance, the author gives the example of the young ham, who was a poor student, to prove the decay of the "art." Also, the "appliance operator" was derogatorily compared to the housewife as being only capable of pushing buttons. Yes, this was scanty the evidence the author gave to substantiate his low opinion of the state of affairs of ham radio.

I submit that these deductions are illogical. Let's stop and think! For example, if a particular person has black hair in a family, does it mean everyone in the family has black hair? If a young ham gets poor grades in school, does it mean that all hams are poor students

or even poor theoreticans? Or if a few hams can't repair their gear themselves, does it mean all hams are not technically inclined? No. No. No. No one has the right to generalize that what may be true for one, ten, or ten thousand is true for all two hundred fifty thousand. Anyone who so reasons only fools himself.

What tickles my funny bone even more is the pseudo-sophisticated attitude of advocates of the Incentive License plan. I especially refer to Board Members of the ARRL, the originators of this farce proposal. These same men who back Incentive Licensing and also accuse the ham of being an appliance operator are responsible for the very condition that they criticize. Rather inconsistent and paradoxical, isn't it?

Our ecenomy is based upon the principle of profit motivation. If an electronics company can run a profitable operation by manufacturing amateur equipment, they are violating no law. However, the manufacturers are stimulus to the so-called "appliance operator" condition. If the ARRL is opposed to the appliance operator, and therefore, commercial equipment, why do they accept the advertising funds of the electronics companies? Their actions certainly contradict their theory in wanting incentive licensing.

It is my belief that the Board of Directors of the ARRL has broken the fiduciary relationship between the ham community and themselves. Why weren't we consulted through opinion surveys in their monthly publications? They say the cost was too high and the time too short. This was an answer from a Chicago resident board member. Well, if one takes an attitude as this, it is primi-facia evidence that they don't know the definition of fiduciary or trust.

In summary I would like to comment on the rationalization referred to above. Obviously the ARRL Board has been procrastinating and now conjecturing about the effect of the Incentive Licensing proposal on the forthcoming international conference in Geneva. Any leverage the ARRL thinks it might acquire by the Incentive Licensing program is strictly imaginary. The rising nations of Africa will not listen to promises or suppositional "ifs." International politics is too complex to reduce the argument of frequency allocations to such simplified terms. We can not equate the international scene and its problems to a mere affirmation or disaffirmation of the Incentive Licensing plan. Decisions will be made upon the basis of politico-economic considerations; not incentive licensing as the ARRL would have you believe.

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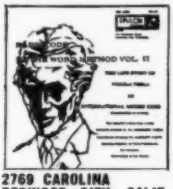

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(W2NSD from page 71)

and adequate documentation to prove that such a trend does exist. This has been one of my main complaints right from the start: the ARRL is proposing legislation without showing that there is any need for it. I have been asking them since last February to provide one single shred of evidence that there is a trend or a need and they have never answered my question.

The Bill Orr article which I printed last month was, unfortunately, a beautiful example of the vagueness and misdirection that is being used to cloud this ARRL move. Bill, who is a good friend of mine, dared me to print his views. I did. But, having been around ham radio for enough years to remember back to the Elysium fields of 1940 to which Bill refers so nostalgically, I can say that I believe things have changed very little. In those days I spent a lot of time going around visiting amateurs and even though more of them built their gear, I don't remember them as the supermen they are billed as today. Though there are no statistics to prove things one way or the other, I remember meeting one ham who had built his own receiver (1940) and I was quite impressed. This was almost unheard of then. He built it from an article in the Handbook and never got it working quite as well as a $29.50 Hallicrafter Skybuddy. I built a receiver in 1937, an all band job from 200 kc to 100 mc. It was lousy. I didn't know any more about radio by 1942 than about 200,000 amateurs today. The Navy put me through their radio and radar school and made me an "expert."

So much for all that hogwash about todays amateurs trending anywhere that requires immediate and drastic regulation changes to correct. I was back there . . . I was one of them . . . don't hand me all that baloney.

Now, to the matter at hand. The FCC is being pressured to push this RM-499 through. If you are opposed then it is up to you to push the other way. You may not care one whit about the philosophical arguments presented, merely being furious about their intended destruction of the Conditional Class license. You may merely disagree with the dictatorial way the ARRL has gone about this. No matter the motivation, this is probably a good time to speak up. Write to the FCC (with original and 14 copies) giving your arguments. Give your Senator or Representative the details on what is happening. Even one of the 15 word Congressman special telegrams for 94c is worth while. If you can't manage to work up 15 copies of your comments then we'll type them up here and run them off for you on our offset press for $2 per double spaced typed page and return 20 copies to you. Your local printer can probably save you time on this . . . and perhaps money.

It is interesting to note that protest hamfests are springing up all around the country. The fellows down in Texas figure they will get between 1500 and 2000 angry amateurs together in Brownsfield on November 9-10. This, together with my mail, would lead me to believe that the "significant percentage" of amateurs who are supporting the League move must be miniscule.

The first IOAR Bulletin is now available. This is a 32 page reprint of the more erudite letters received con and pro the ARRL hassel. It makes fascinating reading. Send a dollar for 12 issues of the Bulletin, or 20c for this single one.

Touring

The first Institute Tour was such a striking success that we are naturally anxious to set up more such trips. We were able to take 73 hams and their wives on four day visits to London, Paris, Geneva, Rome and Berlin with all expenses except lunches and dinners paid for only $560 each. This included hamfests in all except Rome, where we had a personal tour of the Vatican and an audience with the Pope (arranged by Hammarlund), plus guided tours of both West and East Berlin. When you consider that the normal tourist air fare for this trip is $630 and that we traveled by jet everywhere except into Berlin, this is amazing.

Virginia has firmly cancelled my idea of a round-the-world tour for this coming spring, pointing out that I'd do a lot better to devote my time to building up 73 and the Institute instead of trying to make plane, bus and hotel arrangements in fifty different countries. She's right, of course.

This won't stop me from setting up the Scandanavian tour for September and maybe another European tour for October. We'll plan on starting the first tour August 30, with four days each in Oslo, Stockholm, Helsinki, Berlin and Copenhagen. This is the best time of year for a visit to these countries. We'll return September 21st, three weeks later. The cost of the all-expenses (except lunches and dinners) tour will be about $600. This is a lot less than the tourist air fare to Helsinki. This is a little higher than I thought we would have to charge, but I had reckoned without all those airport taxes that other countries charge and little extras for hamfests.

We are planning a second tour of Europe to London, Paris, Geneva, Rome and Berlin

to leave New York on September 27th and return three weeks later on October 19th. This one will also run about $600 unless there are some increases in air fares. We can handle a maximum of 75 hams and wives, so if you are planning on this please let us know as soon as possible. This tour is being planned to coincide with the 1964 Convention of the International Amateur Radio Club in Geneva.

An enterprising amateur is opening a hotel that is particularly aimed at the ham trade. I'll try to have full information on this one by next month. Located on Curacao, it will feature ham shacks for all visiting hams, ham stations on their fleet of boats, instant licensing for visitors, facilities for water skiing, skin diving, fishing, and everything you would expect in a fine resort hotel. If it is at all possible we will arrange a ham tour for this spring to this nearby spot.

. . . Wayne

New Product

The newest toy at 73 Headquarters is our tape embossing machine. This handy little gadget makes raised labels of either one or two lines for marking antenna feedlines, rig controls, and parts cabinets. Virginia has even used it for marking kitchen cannisters and the dog's collar. The adhesive labels stick to almost anything and provide a permanent nameplate.

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Culled from the Journals

Who says the professional journals are dry as dust? While searching through the back files of Proceedings of the IRE for an obscure reference on broad-band, ferrite core transformers, the following gem was spotted on page 1383 of the August, 1959 issue. In a submission entitled "Some Notes on Space Communications," John P. Costas writes:

> "Before the author is accused of being a theoretician [5] . . ."
>
> "[5] Theoretician—one who has been trained to assume everything but responsibility."

Incidentally, this boy Costas just doesn't give up. He was the original pusher of double-sideband [1] and in this submission he was right in there pitching on the proper ratio of sideband to carrier power for phase-lock detection.

. . . W4WKM

[1] "Synchronous Communications," Proc. IRE, Vol. 44, PP. 1713-1718, Dec. 1956.

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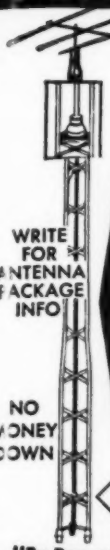

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W9DUT-1 ..... $18.50

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W9DUT-2 ..... $20.00

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TONE MODULATED CRYSTAL STANDARD. Uses one tube and one mc crystal to generate 1 mc markers all the way up through 225 mc. The built in tone generator makes it possible to easily identify the markers. Including Minibox, tube, vrystal, etc. See Oct. '62 p 26.
W9DUT-3 ..... $15.00

TRANSISTORIZED MODULATOR. 40 watt modulator, excellent for plate modulating mobile rigs, four transistors, uses 12 volts dc, only draws 250 ma while resting with peaks of 4-5 amperes. Kit includes transistors, transformers, resistors, condensers, etc. See Sept. 62 p 24.
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W2LLZ $13.00

WRETCHED K2PMM

BADGES $1.00 each.

One of the big problems at hamfests and club meetings is to have everyone plainly enough marked with their first name and call. All sorts of stickers and pieces of cardboard have been tried, plus little cards which can be typed up and stuck in holders . . . all have the same problem: they are hard to read from any distance.

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ATV Bulletin. In direct refutation to the ARRL claim that amateurs are lagging technically are the 2000 readers of the semi-monthly Amateur Television Experimenter Bulletin, edited by W0KYQ. If you are at all interested in amateur television you should subscribe to ATV, the only source of operating and technical info on this amazing branch of our hobby. Back issues are virtually all sold out, so don't put off subscribing. $1 a year for six issues.

5-7-9 Bulletin. Editor is that well known old time contester W1AER. This bulletin, published monthly, lists every contest known to exist for the following two months, giving the rules for those which probably will not appear in QST or CQ and the results wherever available. The bulletin is leading a lively discussion of recent rule changes on ARRL contests, and other matters of interest to contesters and certificate seekers. $2.00 a year.

73 News. Published monthly, editor VE3DQX. Keeps you up-to-date on current ham events. Invaluable to club officials for discussions at club meetings. Good source material for club bulletins. 1.00/year.

Ham-RTTY. This is the most complete book on the subject. Written for the beginning TT'er as well as the expert. More complete and authoriative than books at twice the price. Pictures and descriptions of all popular machines, where to get them, how much, etc. $2.00

Bound Volume 2. Complete library volume containing the 1962 issues of 73. $15.00

Binders. Bright red leather binding. Specify which year you want stamped on them: 60-1, 62, 63. Darbs. $3.00 each.

Care and Feeding of Ham Clubs—K9AMD. Carole did a thorough research job on over a hundred ham clubs to find out what aspects went to make them successful and what seemed to lead to their demise. This book tells all and will be invaluable to all club officers or anyone interested in forming a successful ham club. Hundreds of grateful letters have been received from clubs who have applied the ideas in this book. $1.00

Simplified Math for the Hamshack—K8LFI. This is the simplest and easiest to fathem explanation of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc. If our schools ever got wind of this amazing method of understanding basic math our kids would have a lot less trouble. 50¢

Index to Surplus—W4WKM. This is a complete list of every article ever published on the conversion of surplus equipment. Gives a brief rundown on the article and source. $1.50

Ham-TV—WØKYQ. Covers the basics of ham-TV, complete with how to get on the air for under $50. Not the usual theory manual, but a how-to-do-it book. $3.00

Surplus TV Schematics. You can save a lot of building time in TV if you take advantage of the real bargains available in surplus. This book gives the circuit diagrams and info on the popularly available surplus TV gear. $1.00

AN/ARC-2 Conversion. This transceiver sells in the surplus market for from $40 to $50 and is easily converted into a fine little ham transceiver. Covers 29 mc (160-80-75-40 meters). This booklet gives you the complete schematic and detailed conversion instructions. $1.00

AN/VRC-2 Conversion. Completely different from the ARC-2. This book gives you complete instructions on converting the inexpensive VRC surplus gear into a six meter wide band FM transceiver. There are probably over a thousand stations now operating on 52.525 mc around the country. Join the crowd. Fun. $1.00

Coils—K8BYN. Basic book which covers the theory and practical aspects of the many different types of coils found in ham work. Well illustrated. 50¢

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Impedance Bridge. Full scale construction prints for the bridge described in the August 1961 issue of 73. Comes complete with a reprint of the article. Watch out General Radio! $1.00

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Radio Bookshop

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11—16TH EDITION RADIO HANDBOOK—by Bill Orr W6SAI. This fantastic book is loaded with the most understandable theory course now available in our hobby plus dozens of great construction projects. This is the best ham handbook in print by a wide margin. Easily worth twice the price. **$9.50**

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21—VHF HANDBOOK—Johnson (W6QKI). Types of VHF propagation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. **$2.95**

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, to install it, how to tune it. **$2.70**

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90	73 Products
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SILICON RECTIFIER BARGAINS

PIV	2 amp	5 amp	20 amp	30 amp	35 amp
25	....	....	.50	.75	.90
50	....	....	1.00	1.20	1.30
100	....	.50	1.25	1.40	1.50
200	....	1.00	1.50	1.60	
300	....	1.25	1.75	1.80	
400	....	1.50		2.00	
600	2/1.00	1.75			
800	.75				
1,000	1.50				

85 WATT TRANSITRON #2N1212 NPNS
Silicon Power Transistor
#2N1212 **$1.25**

85 WATT POWER TRANSITOR 40 MC Osc.
NPN. Exint for transmitters.
#2N1897 **$1.00 each**

ZENER DIODE 6 VOLT TRANSITRON #1N429 75c

SILICON CONTROL RECTIFIERS

PIV	2 amp	20 amp
50	1.00	2.50
100	1.60	3.00
200	2.00	3.45
300	2.50	3.75
400	3.00	4.35

MESA TRANSISTOR 500 mc
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Germanium PNP, Vce 8 volt, Ic 50 mil, 150 mw power
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3/$2.00

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SIGNAL GENERATORS
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2C39A $7.50 • 3CX100A5 . . . $10.00 • 6161 . . . $35.00 • 4-65A $7.50 • 8005 . . . $14.00 • 807W/5933 . . . .

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Propagation Charts

J. H. Nelson

EASTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7	7	7	7	7	7	7	7	7*	14	14	14
ARGENTINA	14	14	7*	7	7	7	14	21	21	21	21*	21
AUSTRALIA	14	7*	7	7	7	7	7	14	14	14	14*	21
CANAL ZONE	7*	7	7	7	7	7	14	21	21	21	21*	14
ENGLAND	7	7	7	7	3.5	7	14	14*	14*	14	7	7
HAWAII	14	7	7	7	7	7	7	7	14	21	21	14*
INDIA	7	7	7	7	7	3.5	7*	14	7*	7	7	7
JAPAN	7*	7	7	7	7	7	3.5	7	7	7*	7	14
MEXICO	14	7	7	7	7	7	7	14	21	21	21	14
PHILIPPINES	7*	7	7	7	7	7	3.5*	7	7	7*	7	7
PUERTO RICO	7	7	7	7	7	7	14	14	14	14*	14*	14
SOUTH AFRICA	7*	7	7	7	7	7	14	21*	21	21	14	14
U.S.S.R.	7	7	7	7	7	3.5	7*	14	7*	7	7	7

CENTRAL UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	7	7	7	7	14	14	14
ARGENTINA	14	14	7*	7*	7	7	7	14	21	21	21*	21
AUSTRALIA	21	14	7	7	7	7	7	7	14	14	14*	21
CANAL ZONE	14	7*	7*	7*	7	7	7	14	21	21*	21*	21
ENGLAND	7	7	7	7	3.5	3.5	7	14	14	7*	7	7
HAWAII	14	7*	7	7	7	7	7	7	14	21	21	21
INDIA	7	7	7	7	7	7	3.5	7	7	7*	7*	7
JAPAN	14	7*	7	7	7	7	7	7	7	7*	7	14
MEXICO	7*	7	7	7	7	7	7	14	14	14	14*	14
PHILIPPINES	14	7*	7	7	7	7	7	7	7	7*	7	14
PUERTO RICO	7*	7	7	7	7	7	14	21	21	21*	21*	14
SOUTH AFRICA	7*	7	7	7	7	7	14	14	21*	21	21	14
U.S.S.R.	7	7	7	3.5	7	7	3.5	7*	7	7	7	7

WESTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	7	7	7	7	7*	14	14
ARGENTINA	14	7*	7	7	7	7	7	14	21	21	21*	21*
AUSTRALIA	21	14	7*	7	7	7	7	7	7*	14	14*	21
CANAL ZONE	14	14	7	7	7	7	7	14	21	21	21*	21
ENGLAND	7	7	7	7	3.5*	3.5*	3.5	7	14	7	7	7
HAWAII	21	14	7*	7	7	7	7	7	7*	14	21	21
INDIA	7*	7	7	7	7	7	7	7	7	7	7*	7*
JAPAN	14*	14	7	7	7	7	7	7	7	7*	7	14
MEXICO	14	7	7	7	7	7	7	7	14	14*	21	14*
PHILIPPINES	14*	14	7*	7	7	7	7	7	7	7*	7	14
PUERTO RICO	14	7	7	7	7	7	7	14	21	21*	21*	14
SOUTH AFRICA	7*	7	7	7	7	7	7	7*	14	21	21	14
U.S.S.R.	7	7	7	3.5	7	7	7*	7	7	7	7	7

* Means next higher frequency might be useful.

Good: 2-4, 10-11, 15-18
Fair: 1, 5, 9,14, 19, 24-28
Poor: 6-8, 12-13, 20-23, 29-31
Es: 5-6, 14-16 (High MUF and/or freak conditions)

Items of Interest

The fine article "Why Johnny Ham Can't Hear" by W6VAT in the October issue of 73 should be read by all amateurs.

This article goes a long way toward explaining the difficulties and dangers of frequency predicting.

It also points out why amateurs, working on low power, should work as close to the MUF as possible. There is less noise and less adsorption on the higher frequencies.

The asterisks (*) in the frequency prediction charts show what hours of the day it might be more profitable to go up one band in frequency. A 21* means that if 28 is going to get through at all, this is the best time of day to try it. It probably will not be very active at this part of the sunspot cycle.

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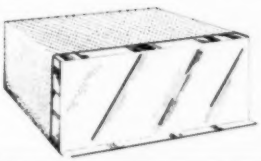

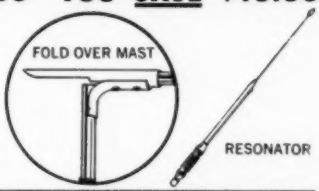

CESCO SWR BRIDGE	GALAXY D.C. POWER SUPPLY	"HUSTLER" ANTENNA WITH 75-40-20 RESONATORS AND MAST
Model CM-52, a must for any mobile station to obtain maximum performance. Accurately measures standing waves 2 through 200 Mc, with a sensitive built-in meter. Ham Net $29.95.	G300D—the only DC power supply that delivers full power to the Galaxy. POWERFUL, RUGGED, RELIABLE. Transistorized 12 VDC. 4½" x 6½" x 8". Encased in gleaming cabinet of nickel-plated steel. Wt. 8 lbs. Outputs for maximum Galaxy tune-up power: 800 VDC @400Ma, 95 VDC bias @30Ma, 325 VDC @200Ma. Ham Net $119.95	The "Hustler" Antennas have been field tested by over 10,000 Hams, proving dependable performance, as well as offering versatility on band changing and garaging. Choice of body or bumper mast. Handles the power of the Galaxy. Total Ham Net $37.80.

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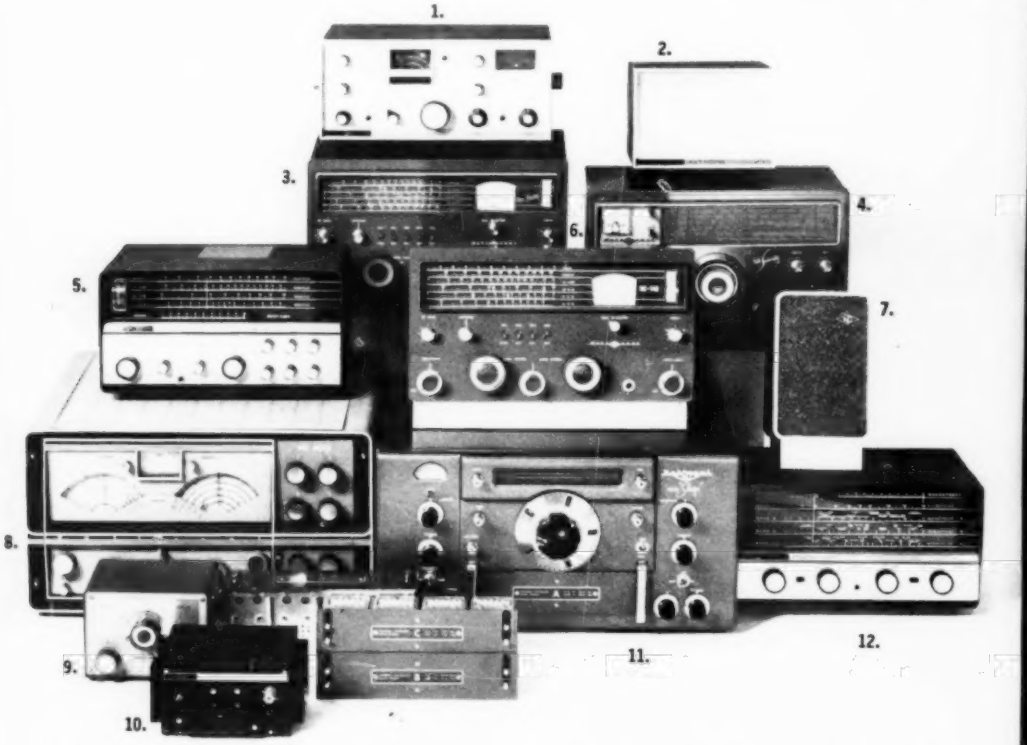

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